सत्यमेव जयते

INDIAN AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

I. A. R. I. 6.
MGIPC—S1—6 AR/54—7-7-54—10,000.

Library,
Indian Agricultural Research Institute
New Delhi (India).

The Empire Cotton Growing Review

Journal of the Empire Cotton Growing Corporation

INCORPORATED BY ROYAL CHARTER 1ST NOVEMBER 1921

Vol. XIV. 1937

Edited by
J. C. WILLIS, M.A., SC.D., F.R.S.

16154
IARI

Published by
P. S. King & Son, Ltd., 14, Great Smith St., London, S.W. 1
for the Empire Cotton Growing Corporation

Quarterly: Price 1s.
Annual Subscription, 5s. post free

Printed in Great Britain

THE EMPIRE COTTON GROWING REVIEW

THE
EMPIRE COTTON GROWING
REVIEW

VOL. XIV. JANUARY, 1937. No. 1.

HELPING TO BUILD AN EMPIRE INDUSTRY

BY

L. G. KILLBY,
Secretary, Empire Cotton Growing Corporation.

THE Empire Cotton Growing Committee of the Board of Trade, to whose Report the Empire Cotton Growing Corporation owes its origin, defined the problem set them as " the adequate development of the Empire's resources for the production of cotton," and it was for the fuller study of this problem that the Corporation was established and began work in 1921, in which year it received its Royal Charter. It has been suggested to me that readers of the REVIEW might care to have a general survey of the principal lines of approach that have been followed in developing cotton-growing in the Empire in the course of the last fifteen years, including in particular some account of the advances that have been made as a result of the application to the problem of science in its various branches. In the following article I have done my best to produce what was asked of me; it will be understood that it is only of the part played by the Corporation that I can speak at first-hand, but it is hoped that the descriptions given of the work of the Colonial Agricultural Departments and other bodies in developing cotton-growing are also substantially correct.*

The view of the Board of Trade Committee was that the solution of their problem was to be sought in " the acquisition of necessary knowledge, and the supply of men to apply that knowledge"; this finding the Corporation's experience speedily confirmed, and on it they have consistently based their policy during the last fifteen years.

*** If, however, there are any important mistakes, the Editor asks me to say that he will welcome contributions in correction of them, but to add that such contributions would come under the category of " Correspondence." (I have elicited that the significance of this warning is that there is no payment !)**

During this period several of the problems confronting the Corporation and others interested in the development of cotton-growing have changed, both intrinsically and in their relative importance, but they still all remain essentially various aspects of the same main problem as defined by the Committee, namely the search for knowledge that will throw light on them and for the right men to apply that knowledge.

It is worth while recalling, perhaps, that the idea that agriculture may derive help from science is a comparatively recent development of the last fifty years. Government grants for research date, in fact, from 1910 only, when the Act setting up the Development Fund was passed. Since that time increasing sums have been voted each year for research work; indeed, last year, at the Annual Meeting of the Corporation, the Rector of the Imperial College of Science and Technology gave the timely warning that it was just as easy to waste money on research as on anything else. Nevertheless, the sums available for agricultural research are still infinitesimal compared with the value of the industry, and nowhere can such work be depended upon with greater confidence to give valuable results than in the tropical parts of the Empire.

Very early in the Corporation's existence it became clear that the dearth of men with an adequate training in tropical agriculture and in the allied sciences was in itself the chief limiting factor in the acquisition of the necessary knowledge, and in 1921 one of the first steps they took was to lay down a scheme for training a staff in accordance with the best scientific advice that they were able to obtain. By means of scholarships provided by the Corporation over eighty men have now been enabled to receive such a training, and the majority of these men are now directly concerned with the production of cotton, either as members of the staffs of the Agricultural Departments in the Colonies in which cotton is grown, or of the staff of the Corporation itself at one or other of its Experiment Stations.

In 1926 the Colonial Office adopted a scheme of agricultural scholarships almost identical with that instituted by the Corporation, and it is impossible to exaggerate the importance of the effect that has been produced by this means on the technical quality of the agricultural staffs of the Crown Colonies. Special mention must also be made here of the work of the Imperial College of Tropical Agriculture, Trinidad, where almost all the holders of Colonial Office and Corporation Scholarships have received part of their training. Without any question the work of the College has contributed more than any other single factor to the degree of success which has attended the Corporation's efforts to increase the output of cotton in the Empire and to improve its quality.

Partly, at all events, as a result of these efforts, the output of cotton from those countries with which the Corporation is concerned (*i.e.*, those countries of the Empire other than India) has increased from 166,000 bales in 1921 to 772,000 in 1936. Details were given in an article by Sir James Currie in this REVIEW in July last; it is not intended, therefore, to give any further crop statistics here, but to present a general account of the various directions in which specialized knowledge is being acquired, the manner in which it is being applied to the solution of cotton-growing problems, and also to make an attempt to estimate the degree of success that has been achieved.

Firstly, given a country that is suited to the production of cotton both as to its soil and climate, development can obviously take place by three means: (1) By natives growing cotton for themselves on their own holdings; (2) by European farmers, working with native labour, including cotton among the crops they grow; and (3) by the extension of the operations of plantation companies growing cotton. The majority of the ways in which scientific knowledge can be used to assist these developments is applicable to all these three means of extending the crop. Those that can only be of service to European farmers and plantation companies, however, will not be dealt with in this article, as the Corporation hold the view that, except under certain special conditions (*e.g.*, those attaching to the concession of the Sudan Plantations Syndicate), the future of Empire cotton growing depends on the intelligence and industry of the native cultivator, guided by well-informed advice from a highly qualified agricultural service.

In what follows the various ways in which assistance on such lines is being given to the industry are described in brief.

SEED SUPPLY.

A first essential in the development of cotton-growing in any country, no matter whether the crop is grown by native cultivators or by European farmers, is a supply of reasonably pure seed of a variety suited to local conditions. To secure this, two organizations are required: (1) An experiment station under an experienced plant breeder, and (2) a seed farm where the seed produced at the experiment station can be kept pure and multiplied up to a stage at which it can be distributed to the growers.

It is on this side of the work that the Corporation concentrated their attention from the start. Realizing the shortage (almost the non-existence) of experienced plant breeders, they sought to supply the need by training suitably qualified men by means of post-graduate studentships, usually tenable at Cambridge and at the College in Trinidad. In the early days, before any of these men had completed their training, it would have been difficult to have made a start at all had not a few trained plant breeders and agriculturists been available from the Indian Agricultural Service. Even so, the urgent need for plant breeders, and the shortage of senior officers, made it impossible for many of the younger men on completing their training to serve for a time under experienced workers before taking up independent posts; it is true that they rapidly learned to profit by their inevitable mistakes, but they might perhaps have been saved from such mistakes had it been possible for them to have served an apprenticeship under senior plant breeders. While it is true that in such an event progress might have been more rapid, the fact that these young plant breeders proved equal to the situation and to working out their own salvation is a notable tribute both to their own qualities and to that of the training they had received.

The Corporation's Experiment Stations, where work on the breeding of cotton has now been carried out consistently for several years, are situated in South Africa, Southern and Northern Rhodesia, Swaziland, Nyasaland and St. Vincent. In addition, they pay the salaries of the Chief Plant Breeder and of two of his Assistants in the Sudan Government Service. In Uganda, the Chief Botanist, one Assistant and an Agricultural Officer with some special plant-breeding training, are among the twelve members of the staff of the Agricultural Department who formerly held studentships awarded by the Corporation.

It may be of interest as illustrating the general lines on which plant breeding is being carried out if a short account is given of the main piece of work that has occupied the attention of the Corporation's staff at the Station at Barberton in the Transvaal. When work at that Station was started in 1924, the chief limiting factor to successful cotton-growing in that part of South Africa was damage caused by an insect called the jassid. The varieties then grown were all more or less susceptible, and this was also true of the cottons grown in other countries, such as Nyasaland and Tanganyika. A start was therefore made on work directed towards the production by selection of jassid-resistant types. One difficulty was to find plants that combined high yield with good lint and jassid-resistance. A certain number of plants were selected, however, and one of them, a selection from the Uganda variety, was given the identification number U.4. This plant was selected in 1925. Though not possessing all the characters required in an ideal cotton plant, it was better than any other selection, and in particular it possessed a high degree of jassid-resistance. Seed from this one plant was accordingly kept separate and multiplied in successive seasons until in 1929, only four years later, 220 tons of seed were available. During these intervening years, though obvious off-type plants were removed from the multiplication blocks, no further purification was done owing to the pressing need of the cotton growers for a type that was even moderately jassid-resistant, and the bulk was naturally very mixed. Nevertheless, it was a great improvement on any of the local varieties, so it was put out into general cultivation, and the cotton-growing industry in the neighbourhood was undoubtedly saved from extinction.

In the following year single-plant selection work was started, and has been going on continuously ever since. One difficulty that is constantly encountered in work of this kind is that a plant which shows an improvement in one desirable character not infrequently shows a deterioration in several others. Thus a higher jassid-resistance can perhaps be obtained, but at the expense of lint length and yield, so that selections have ultimately to be made on a basis of yield of lint without loss of desirable lint characters.

Furthermore, a new line of work is in progress with a view to improving the character of this variety of cotton. U.4 was sent to the Corporation's Station for long-range research work in Trinidad, and there crossed with a number of other varieties. One hybrid in particular seemed specially promising, namely a cross between U.4 and the very hairy type, Cambodia, the progeny being back-crossed to U.4. It is too early yet to say how this experiment will succeed, but it looks as if some useful material may be obtained from it.

This piece of work resulting in the production of the strain U.4 at the Corporation's Station at Barberton has already benefited countries far distant from South Africa. U.4 seed was sent for trial elsewhere, and selections from it now constitute the only variety grown in Southern and Northern Rhodesia and in Nyasaland. In parts of Tanganyika, also, it has been grown with some success, though it still remains to be settled whether it will be as well suited to its new environment as some of the local types. In the Eastern Province of Uganda, it appears that U.4 selections are likely to provide the type that will ultimately be grown throughout the

Province, and in those parts of the Sudan, also, where cotton is grown under rainfall, U.4 selections have been shown to have considerable possibilities. Moreover, favourable reports on the behaviour of this strain have also been received from the Belgian Congo, where it has shown clearly its high yielding power in the face of severe jassid attacks, and has maintained and even improved upon its original lint characters.

Another outstanding piece of plant-breeding work was the selection of a strain of Sakel cotton in the Sudan that is resistant to Leaf Curl disease. Of this it is hardly too much to say that it was this work, coupled with control measures adopted as the result of much patient research work by entomologists, pathologists, and others, that averted the disaster in the Gezira that would undoubtedly have occurred if the disease had not been checked.

Leaf Curl is by no means the only factor capable of having a serious effect on the Gezira yield, and in 1926-27, before the disease had swept through the area, an individual plant of Sakel cotton had been selected on account of its power of standing up to the climate and soil conditions of the Gezira better than those forming the general bulk of the crop. The progeny of this selection was already being grown by the Plant-Breeding Section in 1928-29 when Leaf Curl became really serious, and from this source two plants were selected which showed a very high degree of resistance to the disease. The progeny of one of these plants is now being grown over a large part of the Gezira, where it is producing yields in excess of those given by ordinary Sakel. This selection is not, however, regarded by the technical staff as being their final contribution towards the solution of the problem of securing in the Gezira consistently high yields of a cotton that commands a satisfactory price. The resistant Sakel selection mentioned above has a lint which is not wholly satisfactory in some respects, and the plant breeders are working on other selections and on certain hybrids, by one or other of which means they hope eventually to solve their problem and thus furnish another example of the valuable help that industry can receive from applied science.

A further instance of the work of the plant breeder may be quoted from one of the Corporation's Stations in yet another part of the world. In St. Vincent, where the most valuable type of cotton in the world is grown, the crop formerly suffered severely from a disease known as Angular Leaf Spot. In order to minimize the loss thus caused, the line of attack adopted by the plant breeder was to make single plant selections, choosing those that were attacked latest in the season, or in other words those which showed most resistance to the disease. This method has proved successful, and the disease now causes but little loss of crop.

Another task that has been accomplished by the Corporation's officer in St. Vincent is the purification of the island's strain of Sea Island cotton. At one time two strains of Sea Island were in existence in St. Vincent. Insufficient care was taken to prevent crossing, and extremely serious mixing of seed, and hybridization in the field, had taken place, with deterioration in the properties of the lint. The Corporation reopened the St. Vincent Experiment Station, and the plant breeder in charge set to work to sort out the mixture that composed the island's commercial crop. This has been satisfactorily done by plant-breeding methods, and steps are now being taken by similar methods to improve the yield of lint per acre. At the same time rigorous precautions are taken to preserve the purity that the strain has now acquired.

The examples given may serve to illustrate the way in which plant breeders set to work to effect an improvement in the commercial cotton crop. The major problems differ in practically every country; in one place the main object of the work may be breeding for resistance to some particular disease or pest; in another, the chief desideratum may be early maturity, so that the crop can be grown successfully in a short growing season. But whatever may be the principal factor influencing the work, the examples given may be taken as illustrating the methods employed and will, it is hoped, enable the reader without technical knowledge to form a general idea of what the plant breeders are doing and the lines upon which they work.

Having once obtained a commercially pure strain, it is naturally important to maintain its purity. This, again, is a task in which the cultivator, especially the native cultivator, needs assistance which must be forthcoming either from the Government or from the Corporation.

In Northern Nigeria the Corporation started a cotton seed farm ten years ago at the request of the Government. This farm has been gradually extended until it has now reached 900 acres. The primary object of the farm is the multiplication of strains of cotton selected by the botanists of the Department of Agriculture, and the testing of them under large-scale conditions in order to decide whether they are suitable for general distribution to cultivators. Large quantities of seed have been produced annually at the farm, but in some years the strain selected, when tested on this scale, has proved to have some disadvantage, such as too low a yield or insufficient resistance to disease or insect pests, and the seed from such strains has been discarded in consequence. Even negative results of this kind have their value, however, as they prevent the strain being put into general cultivation, with disappointment to the native growers and a setback to the industry.

Last season a modification was introduced by means of which, in addition to the large-scale multiplication, a second strain is also being grown on a carefully segregated 20 or 30 acres, thus possibly saving a year in the time required to multiply seed up to the general distribution stage, provided that its behaviour at the seed farm is satisfactory.

The farm serves other useful purposes also: thus a good deal of knowledge has been gained, and advice given to local native farmers concerning crops that can be cultivated simultaneously with cotton on the same land. Mention is made later of the use of cattle for cultivation and of manure for maintaining fertility on the farm. The herd now numbers over 180 head, and cattle cultivation takes a very important place in the economy of the farm.

It is proposed gradually to settle native mixed farmers on 10-acre blocks, ultimately devoting to this purpose 500 acres of the total 900 acres at present cleared, and thus to promote the Department of Agriculture's policy for extending this system throughout the Northern Province.

The Agricultural Adviser to the Colonial Office visited the Corporation's seed farm last year and reported that there was no doubt as to its value to the cotton industry of Northern Nigeria. He added that it would be difficult to provide a satisfactory seed supply without such a farm, until mixed farming became well established, and even then it was doubtful if a seed farm could be dispensed with for a long time to come if the industry were to be adequately safeguarded. Further, it was unlikely that there would be large farmers capable of producing pure seed under a system of private seed farms similar to those which have proved so useful in cotton-growing areas in India, and in their absence the maintenance of a central seed farm by the Government or by the Corporation was essential.

All cotton-producing countries realize the necessity of carefully guarding the purity of the seed issued to cultivators, by means either of seed farms under direct European control, or of segregated areas where seed supplied by the Agricultural Department is multiplied by native cultivators with close European supervision and under conditions carefully designed to prevent admixture; in both Tanganyika and Uganda, the Corporation at the Governments' request have given financial assistance towards the establishment and maintenance of such seed farms.

The plant breeder, even where his main objective is the improvement of cotton, cannot rest content with work on that crop alone, however. All whose interest it is to develop cotton-growing recognize that an increased output stands no chance of permanence if it is produced as a kind of agricultural *tour de force* by means of a " Plant More Cotton " campaign. The only way in which the crop will ultimately take an established place in the agriculture of a country is through orthodox farming methods—in other words, it must form one of a properly balanced rotation of crops. The plant breeder, therefore, tries to do what he can to improve the other rotation crops also, and, moreover, his success in that direction may have an important bearing on the extent to which the local cultivators will take up cotton, especially where the latter is a new crop to them. A good instance is furnished by the experience of the Corporation's plant breeder in Swaziland. The types of Kaffir corn usually grown by the natives were quite unsuited for giving high yields in conditions that include liability to severe aphis attack; selection work at the Station has produced an early maturing and dwarf type of plant from which the yield obtained by the native is many times greater than anything he can obtain from his own seed. This fact has had the effect of creating confidence in the plant breeder's advice, and his exhortations on the subject of growing cotton are now listened to by the natives with a respect that they would probably not have received, had he not first given them in a food crop an improvement on anything they could produce for themselves.

TECHNICAL ADVICE.

Stress has rightly always been laid on the necessity to the cultivator of a knowledge of such matters as the best time of planting, the best spacing, and the best means of cultivating the crop. These are naturally always needed when a new type of cotton has reached the stage at which it is about to be put out into general cultivation, and this applies equally to rotation crops, so that at the Corporation's own Experiment Stations and at those maintained by the Agricultural Departments these matters and other problems of cultivation are constantly under investigation, in order that the results when known with confidence may be embodied in advice given to native cultivators. And here it may be said that one of the principal difficulties that has to be surmounted is that of devising a cheap and efficient means of bringing home to the cultivators results obtained at the Experiment Stations. Much can be done by means of native demonstrators, especially if they cultivate some land of their own where those to whom they have to demonstrate a new implement or method of cultivation can see that it is used by the demonstrator on his own plot. Before, however, it is possible to give advice, those responsible need to satisfy themselves, from the results of several years' experiments, of the soundness of the advice they are to give. In a large country, or in a country in which climatic conditions between two cotton-growing districts differ considerably, several stations are needed for such experiments, thus making a proportionately heavy demand on the resources both in men and money of the Agricultural Department. The Corporation have been able to be of some assistance in this direction, as, for example, in Tanganyika, where they have made a grant for a period of years to the Government, to be expended on the creation of new Experiment Stations and the development of old ones, and on the provision of additional personnel.

Pests and Diseases.

There are other problems, notably those of reducing the damage caused by insects and disease, on which the cultivator needs advice that, unfortunately, nobody is yet able to give him with any assurance. The possibility of controlling to some extent such pests as the several species of bollworms and of cotton stainers is one on which several members of the Corporation's staff have now been assiduously at work for some years. A comprehensive series of observations, co-ordinated from the Station at Barberton in South Africa, is being carried out on these pests in Swaziland, in Natal, and in Southern and Northern Rhodesia, while a start has been made on similar lines in Nyasaland also. It is hoped that a collection of records of the behaviour of these insects in the widely different climatic conditions that are found in the various countries named may provide a clue to the point in their life-histories at which they could be attacked with some hope of success. This work requires a comparatively numerous staff and rather heavy expenditure; moreover, it is likely to be prolonged. For all these reasons the Corporation decided that it was an appropriate task for them to undertake, as it would be less easy for the various Agricultural Departments in different countries to arrange for the necessary co-operation, and such work must essentially be co-ordinated from one central Station, a condition which the staffing and equipment of the Corporation's

Barberton Station has enabled it to fulfil. At the present time this investigation with a view to discovering some means of controlling the chief cotton pests is one of the Corporation's principal activities. There can be no doubt whatever of its importance and of the marked increase that would assuredly follow any appreciable degree of success in devising measures of control. As has been said, however, the work will inevitably be long and costly, and naturally success cannot be guaranteed.

The loss of crops through insect damage is everywhere extremely heavy, and in all countries the Government entomologists are working continuously to discover means of controlling the principal pests in their respective areas. It is in the ceaseless war that has to be waged against pests and diseases that the need for more and more knowledge concerning the insect or fungus or virus is seen so forcibly, and its value is brought home by the sometimes spectacular success that may be achieved when the requisite knowledge has been acquired and wisely applied. An illustration is afforded by the story of Leaf Curl disease of cotton in the Sudan, to which brief reference has already been made. Prior to 1924 the disease was unknown; three years later it had begun to spread in the Gezira, and by 1928 nearly 50 per cent. of infection was recorded in that area. During the next two seasons the spread of the disease was even more serious and rapid, and by 1930 practically every plant on some 200,000 acres showed more or less severe symptoms. There is space for only a very brief record of the intensive campaign that was carried on against the disease from 1926 onwards by the Sudan Government's Agricultural Research Service. It was clear that it came within the category of virus diseases, but the first point to be cleared up was the means by which the infection spread. Eventually it was established that white fly was the principal, and probably the only, carrier, and it then became necessary to discover the source from which the insect itself became infected. This was narrowed down when it was established that the infection was not transmissible through the egg from one generation to another, and it appeared that the only possible source was infected cotton. After the picking was completed, the stems of the bushes were chopped off just above ground-level and the roots left to die. But clearly this was not completely effective, as the old roots were sometimes capable of throwing up new shoots when the rains arrived or when a millet crop on the former cotton land was grown under irrigation. Such new shoots were naturally infected from the start with the virus that had permeated the old plant.

In the next place careful experiments showed that the disease was not inherited—seed from badly diseased plants produced perfectly healthy ones; it was fair to conclude, therefore, that the diseased cotton plants of the previous year were the most likely source from which white fly could become infected, and in turn infect the crop of the following year. It was later found, however, that the same disease occurs on a species of malvaceous plant that is grown as a food crop, and this source of infection cannot be eradicated. Attention was concentrated on pulling out all the old cotton stumps by the roots instead of chopping off the stalks at ground-level, and the reduction in the incidence of Leaf Curl in the following season was very striking. Further, the whole of the plant-breeding work was given a new bias with a view to eliminating all strains that showed undue susceptibility to Leaf Curl. Eventually several plants were selected that showed a high degree of resistance, and these have been multiplied up until there should be enough seed this season to sow the whole of the Gezira, if desired. The growing of resistant strains in combination with the introduction of methods for pulling old cotton stumps up by the roots has proved so effective that the Director of Agricultural Research (formerly a member of the Corporation's staff) is able to write that it is now "legitimate to hope that a period of twelve years will have witnessed not only the appearance and sensationally rapid spread of a very serious disease of cotton, but also its disappearance as a factor of any importance in crop yield." The complete story affords a striking instance of the value of a systematic and thorough investigation of all the relevant facts, and of the success that may follow a plan of campaign based on the knowledge thus acquired by men who know how to make the right use of it.

Unfortunately, cotton is a crop that not only is susceptible to a considerable number of diseases, but is also attacked by many pests that are liable to cause serious damage, and the staffs of the Colonial Agricultural Departments and of the Corporation are constantly engaged on investigations that it is hoped may show the way to possible methods of control. One of the most important advances so far recorded in the development of cotton-growing in the Empire was the breeding by the Corporation's staff in South Africa of the variety U.4 which is resistant to the jassid. This piece of work, which has already been described, has benefited cotton-growing over a large part of Africa. Attention has since been concentrated on bollworms and stainers; much valuable information has been gained, but it has to be admitted that their effective control is not yet in sight.

It is essential in studying problems of insect pest control that as many facts as possible regarding any particular pest should be ascertained first of all, and even then it by no means follows that it will be found possible to devise any economic scheme for destroying or avoiding it. What can be said, however, and that with some certainty, is that without such knowledge it is extremely unlikely that any effective means of control will be discovered at all.

Mixed Farming.

But, important as the increased output of crops is sure to be should the work on insects and diseases indicate effective measures for their control, even more far-reaching results may be achieved eventually by the policy of several of the African colonies and Protectorates in encouraging among native cultivators the practice of mixed farming. This revolution, which is now beginning to be brought about in the agricultural practice of African farmers, has been often described, but its bearing, not only on the production of cotton and other crops, but also on the health and welfare of the inhabitants, is so important as to justify brief repetition here.

The method of agriculture that is still most commonly followed is what is known as "shifting cultivation." A man clears a piece of land of bush, leaving stumps and roots in the ground; this land he, with his wife and any children old enough to work, cultivates with the native hoe during the time of year when the rains make hand cultivation possible. Taking Northern Nigeria as an illustration, it is found there that a man, woman and one child are able to cultivate in this way about three to three and a half acres. But all the cultivation has to be crowded into the few months when such work is possible, and it is almost inevitable that some fields are sown too late to give the best yields, while all would be the better for a more thorough weeding. The cultivation period is followed by about a six months' dry fallow, which certainly does much to restore the land, but is not by itself sufficient to keep up its fertility for continued cropping. So periodically part of the land has to be allowed to go back to bush in order to rest it, and a new piece is cleared and cultivated.

The alternative system of mixed farming that the Agricultural Departments are gradually introducing consists in the use of cattle for cultivating the land and the systematic making and application of farmyard manure.

The beneficial effect of the adoption of this method of farming is twofold. Firstly, in order that cultivation by cattle may be possible, it is necessary to clear the land thoroughly, including the removal of stumps and roots, and when once this is done, there is every inducement not to let it revert to bush again, provided that its fertility can be maintained in other ways. This latter object is achieved by the application of farmyard manure. The practice of enclosing animals in pens and providing bedding, which, when rotted down and put on the land with the manure, supplies much needed vegetable matter to form humus, was formerly practically unknown in West Africa, and in East Africa also, except on an island in Lake Victoria where the inhabitants have long ago established the practice of stall-feeding their cattle and applying well made and carefully preserved manure to their land. In this case, apparently, necessity was the mother of invention, as the island has a population of about 600 to the square mile, and unless fertility of the soil could be kept up, the alternatives were starvation or emigration.

The Agricultural Departments have been careful only to advocate cattle cultivation simultaneously with manuring of the land; otherwise there would be a danger that although a greater area would be put under cultivation, there would be no maintenance of its fertility. Fortunately, in both East and West Africa the soils have been shown to give increased crop yields under a far lighter dressing of manure than would be necessary in this country. Sometimes maximum yields are obtained with a dressing of only two tons per acre. In Northern Nigeria the farmers have not hitherto been cattle owners; although the number of cattle in the country was estimated in 1929 at 3 million head, they were all in the hands of the nomad Fulani. The idea of mixed farming was therefore entirely novel; it has been said that "the farmer was asked to leap forward a few hundred agricultural years at once into an era of ploughs, cattle, cows, milk and manuring of land. Farmers are cautious and conservative all the world over, and one can imagine how long it would take to get English farmers to make an equally drastic change in their methods." The extent to which the new system is being taken up in Africa is therefore all the more striking and encouraging. The figures for Northern Nigeria speak for themselves: At the end of 1928 there were 2 mixed farmers; four years later there were 67, and in 1935 there were 621, and this number was actually doubled in the following year. Undoubtedly there is great enthusiasm for the movement and the farmers are for the most part carrying out well the advice and instructions that they have received. Moreover, the Departments of Agriculture in Tanganyika and Uganda are doing their best to develop the system on generally similar lines. Peasant holdings are being established in all three territories, and the farmer is started off with a pair of cattle and the necessary implements for quite a small cash payment, the balance being paid off in instalments over a period limited normally, in Nigeria, to four years. It is gratifying also to be able to record that repayments are being made promptly and regularly.

This question of mixed farming has been dealt with at some length, but this is justified by the fact that, probably more than any other single factor operating at the present time, it will bring about in the normal course a very notable increase in the output of cotton. Further, it should promote the health of the native populations by the increased production of milk, and their general welfare by enabling them with no more labour to multiply several times over their present income from the sale of crops. Moreover, when it is remembered that the system will serve as an effective measure for combating (i) soil erosion due to overstocking, (ii) tsetse fly by means of increased land clearance, and (iii) soil impoverishment by the application of manure, there is ample justification for claiming it as an African agricultural revolution. Also, it should not be forgotten that it will only have been made possible by many years of careful and patient experimental work and propaganda on the part of the Agricultural Departments.

A task of this kind, involving a radical change in the agricultural practice of the native population, is necessarily one that must be undertaken by the local Governments. The Corporation are, however, able to assist in a small way. As suitable farmers can be found, they are dividing up into small holdings 500 acres out of the 900 that they have cleared at their seed farm in Northern Nigeria; each of these holdings will be about 10 acres and will be farmed by a native family using cattle for cultivation and for manuring the land. The Corporation advance these men cattle and implements, for which they pay in instalments as they dispose of their cotton and other crops not grown for food. Moreover, the manager of the farm supervises their work to ensure that a satisfactory standard is maintained. The remaining 400 acres of the cleared area will be retained under direct cultivation by the Corporation for the present for the multiplication of strains of cotton selected by the botanists of the Agricultural Department.

RESEARCH.

In the Report of the Empire Cotton Growing Committee of the Board of Trade, the opening statement of the problem of the means whereby the Empire's cotton resources could be developed began with a paragraph headed " Need for Research," and went on to advocate the establishment of a Research Institute " to study the life of the cotton plant and the development of its lint from all possible aspects, except such as are of merely local interest and profit." A sharp distinction was thus drawn between what have since been differentiated as short-range, and fundamental or long-range, research problems. It may be doubted whether at the present time research workers would agree that the difference is as clearly defined as the wording of the Committee's Report seems to indicate. There must naturally be a difference in outlook and intention between the man who is bound to keep before him the economic application of the results of his work, and his fellow-worker whose achievement is assessed by the purely scientific value of his contributions to knowledge. But the investigations of the former may at any time provide a pointer to a line of research from which important scientific results may emerge, while the history of physical science is full of instances in which investigations undertaken with no thought of their economic application have revolutionized an industry, and the same is likely to prove true of the biological sciences also.

The Corporation recognized very early that there are many fundamental problems connected with the cotton plant, the investigation of which cannot be undertaken by the agricultural or botanical staff of any single cotton-growing country, who have neither the time nor the necessary training and experience for such work. They decided, therefore, to establish a Research Station in Trinidad, where the duties of the staff would be to find out all they could as to how the plant grows and produces lint, and the mechanism whereby its characters are inherited. In their view, investigations on these lines would be sure in the long run to yield results which could be seized on by plant breeders and others engaged in the improvement of the commercial crop and applied to economic ends. The work of the Station needs, therefore, to be assessed primarily by the extent to which its results have enabled such workers to open up investigations on practical problems.

Since the Trinidad Station was established in 1926, eighteen papers have been published on the genetics of cotton, and eleven dealing with physiological problems.

While the need for this long-range research is less easily appreciated than that for the investigation of local problems, the results of which can be applied immediately, the fact that it may lead to discoveries of great importance to cotton-growing is one that must be recognized. Such work could perhaps only be taken in hand by a body like the Corporation, that is free from the pressure of day-to-day problems that confront every Department of Agriculture; and to such a body provision for fundamental research was clearly a duty they could not ignore, even if it were regarded merely as a kind of insurance against the possibility of missing some outstanding discovery. For example, the cotton plant forms each year many more bolls than it can bring to maturity. If an investigation into the conditions that govern its growth were to lead to the discovery of a means whereby it could be made to retain and ripen even a comparatively small proportion of the bolls now shed, the effect on the Empire's annual output of cotton would far exceed any increase that can be expected in the ordinary course of development—an average increase of only 2 per cent. in the number of bolls retained and ripened would mean another 100,000 bales from India alone.

Having decided to undertake this type of research, the Corporation considered carefully to what extent they should prescribe the direction that it should take, and came to the conclusion that the Trinidad Station should work on the Genetics and Physiology of cotton. Apart from this, the staff are free to decide for themselves the lines they will follow. The Corporation's policy has been stated by its Research Committee thus: " The Corporation does not define closely the policy to be adopted by the Trinidad Station in working towards the broad objective, namely to obtain knowledge of the fundamental properties of the cotton plant and lint. It ensures to its staff the freedom in choosing lines and methods of investigation which such an objective necessitates. At the same time the Corporation feel that the work of the Station should be so directed as to conform with the Corporation's inherent obligation to promote the interests of cotton-growing in the Empire. Thus the ultimate aim in seeking fundamental knowledge is the creation of new methods and the improvement of existing ones, in plant breeding and in all the aspects of cotton-growing."

In this connection, a recent expression of opinion by Sir John Farmer is worth quoting: " It is on discovery rather than on the exploitation of discoveries that the opening up of paths of progress mainly depends—when the trail is made, exploitation and improvement are relatively simple matters."

TRANSPORT FACILITIES.

One of the major problems in opening up the undeveloped parts of the Empire has been the question of providing means of transport. Without facilities for bringing a crop cheaply to market it is of little use embarking upon a campaign of extension. Yet until an area is in a position to export a considerable quantity of produce, the building of a railway to tap it is a gamble, and freight receipts are bound in the early stages to lag behind operating costs and interest charges, unless mining is being developed as well as agriculture.

Here again science has come to the rescue, and the advances made in the design and production of motor vehicles have provided means of transport that do not involve the heavy capital and operating expenditure of a railway.

Recognizing the help to development that motor transport could give if the cost of operation could be made sufficiently cheap, the Corporation in 1924 set up a Sub-Committee to study the subject. It was obvious to the Committee that motor vehicles for use in development work must be able to travel over very cheaply constructed roads; also that, to prevent undue damage being done to such roads, especially during wet weather, the pressure per square inch imposed by the vehicle on the road surface must be small—considerably smaller than that possible by using the pneumatic tyres available at the time when the Committee was appointed. Experiments and tests were therefore carried out with lorries fitted with caterpillar tracks on the rear axles instead of wheels, and attempts made to use producer gas generated from charcoal as a substitute for petrol, in order to cheapen running costs. These experiments were of distinct value, as they showed directions in which caterpillar tracks could be improved, and indicated that they were more likely to remain suitable for military purposes than to prove the best form of commercial transport on earth roads, seeing that they were expensive in first cost and also in maintenance, even at low speeds. The various producer gas units which were investigated gave good results in the hands of an expert. It became evident, however, that in comparison with a petrol engine the extra skill required while driving, and the extra trouble involved in cleaning and starting up, were handicaps that would almost certainly prevent the widespread adoption of producer gas, even in areas where good quality charcoal was very cheap and petrol very dear. Further, the weight of the producer unit and the bulk of the fuel considerably reduced the useful load that could be carried.

By 1927 the work of the Corporation's Motor Transport Committee had shown that the investigations and experiments which were so necessary if quick progress were to be made were too widespread in scope and too heavy in cost to warrant their continuing to work alone. The question of oversea transport came up for discussion at the Colonial Office Conference held in that year, and the Committee were invited to give evidence. As a result the Oversea Mechanical Transport Directing Committee was appointed in the autumn of 1928 by Mr. Amery, then Secretary of State for Dominion Affairs and for the Colonies, and Sir James Currie was invited to be Chairman. Twenty-three of the oversea Empire Governments combined to assist in finding the necessary finance, and the Empire Marketing Board undertook to match their contributions. The Oversea Mechanical Transport Council was accordingly constituted, consisting of representatives of these Governments and of the Empire Marketing Board, and to this body the Directing Committee periodically reported progress.

The Committee looked into the possibilities of caterpillar tracks, but during the time that the Corporation's Sub-Committee had been at work the manufacturers had been making considerable strides in the production of large pneumatic tyres that had a reasonable life when run at low inflation pressures. The Committee decided, therefore, to concentrate upon the production of wheeled vehicles as having a number of advantages over the use of tracks. To minimize road wear and to secure a good performance in soft sand, a tractor-trailer unit was evolved to carry under average Colonial conditions a useful load of 15 tons, which could be increased to 20 tons over good surfaces and easy gradients. The tractor, carrying 3 tons, or 4 tons in good conditions, was mounted on two four-wheel bogies, all of the wheels being driven and steered, and two eight-wheeled trailers carried the balance of the load. In this way a 15-ton load was spread over twenty-four wheels, and no axle load exceeded 2¾ tons. Further, every wheel was capable of moving independently of its fellows, thus securing good adhesion for the driving wheels and minimizing shocks to the vehicles and the road.

The first of these units was tested in England for 5,000 miles, and then in the Gold Coast for a further 8,000 miles, after which the vehicles were purchased by the Gold Coast Government. The behaviour of the vehicles showed that few improvements could be made in the design. By this time, however, the compression ignition engine had shown itself to be satisfactory as a power unit for road vehicles; when a second 15-ton unit was constructed, therefore, this type of engine was fitted to the tractor instead of a petrol engine, to economize fuel costs.

The second unit was tested in England and then shipped to Australia. The vehicles covered a total of nearly 10,000 miles in Australia under commercial running conditions, and were then purchased by the Australian Government, who are continuing to operate them. During the tests in Australia the cost per ton mile, after making full allowances for interest and depreciation, amounted to 3·70d., in spite of the fact that loads were available in one direction only, resulting in an average load of 8·72 tons compared with the unit's capacity of 15 to 20 tons. For the sake of comparison, it may be mentioned that motor transport contractors operating in the Northern Territory, where the unit was running, were charging 9d. to 1s. 6d. per ton mile, depending upon the class of goods carried. As a result of the tests in Australia, two similar units were ordered by the Russian Government and one by the Government of Tanganyika Territory. The Tanganyika unit proved unsuitable for operation over a narrow earth-road at the height of the rains, but has behaved satisfactorily during the dry season, though the operating costs have been high, owing to the fact that it has been employed on very short hauls. So far no reports have been received from Russia. The vehicles in Australia had by September 30, 1936 covered 24,000 miles since the Australian Government took them over in November, 1934.

GINNING AND MARKETING.

Any plan to develop cotton-growing in a country, whether the crop is grown by Europeans or by natives, must include the provision of adequate facilities for ginning and marketing. In the early days of Empire cotton-growing the British Cotton Growing Association took care that nothing was left undone by them in this direction. They erected ginneries themselves, advanced money for their erection by others, and in some countries guaranteed in advance the price they would pay native cultivators for their cotton.

Under this stimulus the industry expanded, and, as soon as it was seen that there was money to be made from it, so did the number of the ginneries, until, in East Africa at all events, the local Governments had to pass legislation dividing the country into zones from which seed cotton might not be removed, except as head loads or in canoes. Prior to this, the excessive competition for seed cotton between ginneries in Uganda had led the latter to send out motor lorries to distances up to 60 miles or more to bring in sellers and their cotton. This practice at once greatly increased the rate at which such diseases and pests as can be carried in seed cotton could be spread; moreover, the carriage of seed cotton over considerable distances made it extremely difficult to keep any one strain pure, and the mixing of growths became more frequent. The recent legislation should do much to prevent these evils and thus to maintain the reputation of the crop.

In Tanganyika steps have been taken to guard against the evils that follow the uneconomic multiplication of ginneries. In 1933 it was intimated that no new ginneries could be permitted to be erected until the size of the crop warranted it, and the system of zoning the cotton-growing districts was adopted with a view to preventing the mixing of types by the movement of seed cotton from one district to another. The ginner was thus given a greater inducement to promote the growing of the crop in his own district as well as a greater responsibility for its quality. Other legislative steps also were taken to protect the native grower in the matter of marketing the crop.

In Nyasaland the British Cotton Growing Association erected ginneries, and from 1923 until 1931 they fixed prices at which they would buy the crop at the commencement of each season. During this period the native became more familiar with the idea of growing an economic crop and somewhat more understanding of price fluctuations. The market has therefore now been thrown open, and, as in other countries, the industry is controlled by the Government as regards the distribution of seed, the licensing of buyers and ginners, and the conduct of markets.

The assistance given to the development of Empire cotton-growing by the provision of ginning facilities and of arrangements whereby the cultivators can most easily and profitably market their crop is obvious. Details vary in accordance with the conditions in different countries, and space prevents anything more than the bare summary that has been given above. The subject would, I suggest, make an interesting article in itself if it were presented by someone who is familiar with the principal difficulties in each of the countries, and the manner in which they have been or are being surmounted.

GENERAL.

So far this article has dealt with the various ways in which assistance is being given to the cotton-growing industry, partly through the application of scientific knowledge and partly by the provision of facilities to enable cultivators to reap the benefits of their labours by assuring to them ginning facilities and a market for their crop. This assistance can, however, only have a limited effect on the increase of the cotton crops of the Empire, unless the native inhabitants of the countries where the crop will grow can be persuaded of the advantages to themselves of a cash crop, such as cotton. Their main object in life is naturally to obtain a sufficiency of food; as a rule their needs are few, and where all are agriculturists on their own small holdings, those needs are easily met. Cash is required, however, for payment of taxes, and this is perhaps the first incentive felt by a cultivator to produce a crop which he can sell. The task of providing further incentives rests principally with the Administration, and especially with the Education Department. Vocational training, in particular, serves as a means towards this end, for if the natives are taught, for example, the operations required for the construction of better houses and improved sanitation, a desire for these amenities will in all probability be awakened and competitive enthusiasm be aroused between neighbouring Headmen. When once this idea begins to spread, the native cultivator will readily appreciate the advantages of growing a crop which will bring him money to pay for the services of artisans, and a step forward will have been taken towards creating permanent and useful wants, which will raise the standard of living and simultaneously add to the comfort and welfare of the race. It may be objected that material interest should not provide the principal motive in a desire for better education, but the part that it plays cannot be ignored, and it is just as well to recognize that in all classes the advantage which education can give to the individual in the struggle for existence is usually a more telling factor than the desire for general improvement.

Specialized agricultural instruction must also play an important part in increasing native production. All Agricultural Departments now recognize the value of a staff of trained native assistants, who can act as demonstrators, cultivating either Government Stations or, preferably, their own plots, to illustrate to their fellows the methods of cultivation advocated by the Department. The formation of such a native staff demands effective co-operation between the Agricultural Department and the Education Department in order that the curricula of native schools may be effectively linked up with the principles and practice of agriculture. An adequate supply of suitably trained demonstrators and instructors constitutes, indeed, almost the only means of spreading sound agricultural methods among a large and scattered population. Moreover, personal advice, combined with instruction and demonstration by men of their own race, is probably the most effective means of raising the standard of native agriculture as a whole, and without this a permanent increase in the yield of cotton cannot possibly be achieved.

It is hoped that this survey may have given a general impression of the nature of the problem of developing cotton-growing in the Empire, as well as of the principal means whereby it is hoped to effect its solution. Considering the multifarious obstacles that have to be overcome, and the fact that these are naturally greatest in the early stages, the results achieved in the past fifteen years are undoubtedly encouraging. The foundations of the industry are laid: it is believed that some of the principal difficulties that lie ahead are now foreseen, and if the steps that are already being taken are successful, continuous progress should be assured.

SOME ASPECTS OF THE PROMOTION OF COTTON GROWING IN SOUTHERN RHODESIA

BY

G. S. CAMERON
Cotton Specialist, Southern Rhodesia.

To those who are engaged in the introduction of a new crop, whether cotton or any other produce of the soil, the end in view is clear and definite. We know what we want; we know, more or less, how to set about obtaining what we want; but we do not know, until we embark on operations, the difficulties with which our path is beset.

Just how far the history of past attempts to establish a cotton-growing industry in Southern Rhodesia resemble early efforts in other Colonies and Protectorates is not known, but it may be worth while setting down a brief outline of what is taking place. One speculates sometimes as to whether or not it has been, and still is, a matter of sound policy to keep on hammering away at the various problems which seem so difficult when experienced close at hand. In order to appreciate the position in the right perspective it should be viewed from more than one angle, seeing that the decision as to whether or not cotton growing is ever likely to be a success rests not with one Government, group, or organization but with all combined. History shows that in the promotion of cotton growing in any country wholesale co-operation is necessary between the Imperial Government and the local Government, while the stimulus that has been, and is, provided by the British Cotton Growing Association and the Empire Cotton Growing Corporation is of inestimable value. A Colonial Government and its farming population can do very little for themselves in the matter of cotton growing without advice, help, and direction from the Imperial Government and the great organizations already mentioned. Governments change, both Imperial and Colonial, and farming populations, particularly in recent years, have been at the mercy of depressed economic conditions, so that they have to produce what pays them best at the moment, without being in a position to follow a set programme which would pay them better over a number of years, and which would conform to better farming practice.

One still hears the Southern Rhodesian farmer abused for his undue optimism in regard to cotton away back in 1923 and 1924. But the farmers were not the only ones who went astray on that occasion. Administrators, officials and even hard-headed men of commerce were swept off their feet at that time, not only in Southern Rhodesia, but wherever cotton showed the faintest promise of success, outside as well as inside the Empire.

Of the several features which precipitated the cotton boom in Southern Rhodesia possibly the price factor was the most important. The first crop sold at 18d. to 20d. per lb., and at such a price it does not require a heavy yield per acre of seed cotton to make a handsome profit.

Another important feature was the fact that only relatively small acreages were grown. Judging by the yields that were obtained many of these small acreages must have escaped insect damage, particularly jassid and bollworms. The two years immediately following the boom clearly demonstrated the futility of attempting to grow a variety of cotton that did not possess a high degree of resistance to jassid.

By the time that Parnell's U.4 became available for general distribution the bottom had fallen out of the market, and prices were not sufficiently remunerative to induce growers to plant even moderately large acreages. Had it been possible to obtain uniformly high yields per acre, it is probable that low prices would not have been such a deterrent to cotton growing, but the jassid pest was no sooner overcome than it was found that the yield per acre was drastically reduced by American bollworm in the bud- and flower-forming stage of the plant's development. It has been difficult to get farmers to realize that bollworm can do so much damage before bolls are actually formed, and many are still unaware of the fact. They have got it firmly into their minds that a bollworm must necessarily attack a boll, and one frequently hears it stated that a field of cotton failed to produce a good crop although bollworm was not in evidence. This very rarely happens except in cases of severe and prolonged droughts, when, undoubtedly, much bud and flower shedding does occur.

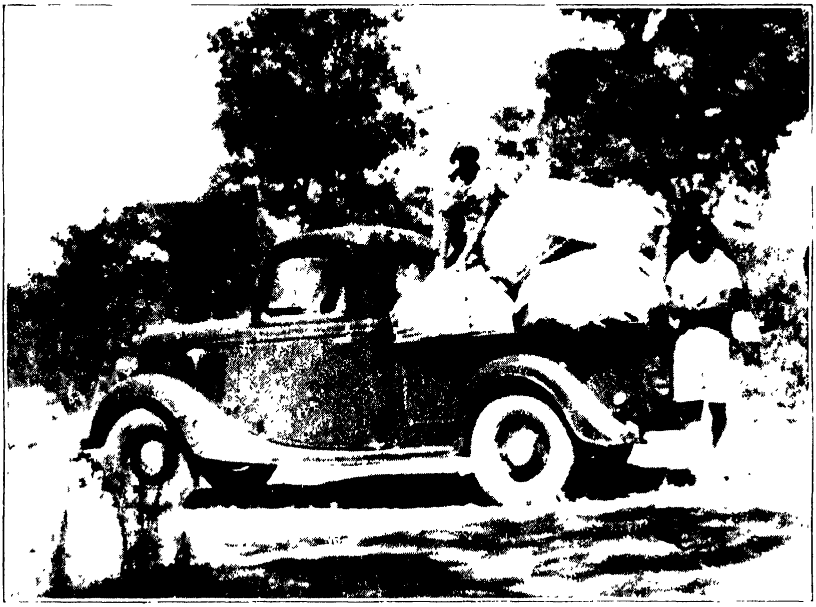
It must be borne in mind that, in Southern Rhodesia, cotton is mostly grown in the maize-producing areas, and that the chief pest of cotton is American bollworm, which also attacks maize and any other crop that happens to be in flower at the time. Once the maize crop has passed the " tasselling " stage it is no longer attractive to the egg-laying moth of American bollworm, and the moth has then to look for any other crop in flower on which to lay her eggs. Cotton at this time is flowering profusely, and forms a further breeding ground for the adult moths which have been bred up on the maize crops.

Without going into precise details as to the proportionate acreage of maize to cotton it may be taken as, roughly, 100 to 1. It does not therefore require much effort of the imagination to realize what happens to cotton fields in flower once the maize ceases to be attractive to egg-laying moths. One may be excused for speculating as to what would happen in the event of a lesser proportion of maize being grown to cotton, or conversely a larger acreage of cotton being grown to maize. Would the wider dispersion of the adult moths over a larger acreage reduce the intensity of the bollworm attack ?

For many years Southern Rhodesia has been a maize-exporting country, and as maize meal is the staple food of the native population there has been a good local market in the past. When the price of export maize fell below cost of production the maize growers were in a very difficult position, and were only saved from ruin by the imposition of a controlled price for all maize sold on the local market. Maize control, which was introduced as a temporary measure, is still in existence. How long this state of affairs is likely to last is not known, but very obviously it cannot go on for ever. As long as it does continue, however, the maize farmer is not likely to worry overmuch about alternative crops unless they are more remunerative than controlled maize.

This accounts, to a certain extent, for the lack of *immediate* interest in cotton growing. I say immediate interest advisedly, because the better-class maize farmer knows well enough that the future of European-grown maize is in jeopardy owing to the increasing quantity of maize grown by natives. At present the native is only allowed a small share in the local market, but as time goes on he will have to be given an ever-increasing share. The time is not far off when the natives of Southern Rhodesia will be able to grow all the maize required for local consumption, and have a surplus for export as well. How long will it be possible to keep the internal market largely as a preserve for the European maize grower ? This is a knotty political problem involving the so-called " White Rhodesia " policy, into the pros and cons of which it would be as dangerous to embark as it would be futile, in this article. It has to be kept in mind, however, as a very important aspect which has a direct bearing upon the future of cotton-growing here. Maize is a low-grade, bulky product sold by the hundredweight, and transported

Weighing Native Grown Cotton by means of a Spring Balance Slung from a Branch of a Tree.



Type of Motor Truck used for taking Native Grown Cotton to Nearest Point on Rail.

long distances by rail from an inland territory to the coast. Cotton, on the other hand, sold by the pound and pressed to a high density, should, in the long run, prove the more economical crop for a country in the geographical situation of Southern Rhodesia. Another point to which sufficient prominence has not been given in the past is the low cost of production of cotton when compared with the cost of producing maize. Where the latter scores, in that initial cost of cultivation may be less, this is more than offset by the high cost of artificial fertilizer and the bagging of the crop. Cotton in this country does not need fertilizer, and the woolpacks required for sending the seed cotton to the ginnery can be used over and over again. Opinions differ as to the cost of production per acre of both crops, but it is more than likely that maize costs per acre are at least 50 per cent. more than is the case with cotton.

Let it not be thought that the writer is having a " tilt " at the maize-growing industry, for such is far from being the case. It is agreed by all who can speak with authority on both crops that they fit admirably in a proper scheme of rotation. Where a difference of opinion may exist is in the proportion in which the one crop is grown in relation to the other. It is difficult to understand why a crop which requires to be grown by the aid of a subsidy, in the form of control, should be grown to the extent that a considerable part of it has to be exported at a loss. This is not speculation, it is a recent historical fact. Much of the tobacco crop of Southern Rhodesia is grown in areas suited to cotton, but tobacco growing takes up such a lot of time that the tobacco grower has little to spare for other branches of agriculture. In fact, tobacco growing is such a specialized branch of agriculture that its growers might be classified as planters rather than farmers. This does not mean that they are not good farmers; the majority of them are. The industry is aided by the large preferential duty on Empire-grown tobacco imported into the United Kingdom, and while the preference lasts the tobacco grower can hardly be blamed for making the most of it. Cotton fits in admirably with tobacco growing, except in certain high veld areas where the average season is probably too short for it.

Many people, mostly cattle ranchers, believe that the future of agriculture in Southern Rhodesia depends on the cattle industry. If this be true, then it is going to be an uphill struggle in the future even as it has been in the past. Not only has the export of chilled beef to be subsidized by bounties, but the last few years have been extremely trying on account of frequent outbreaks of foot-and-mouth disease in addition to East Coast fever. Over and above these difficulties there is the presence of large numbers of native-owned "scrub" cattle which are a constant menace to local supplies.

From what has been said it will be realized that the three principal agricultural products of Southern Rhodesia are subsidized directly or indirectly by controls, preferences and bounties. As such they cannot be reckoned as being on a very sound footing; in fact, the writer would go further and suggest that they are in rather a precarious situation. Maize control and the cattle levy are local problems for the Government to manipulate as best it can. The preference on Empire-grown tobacco is a matter which rests entirely with the Imperial Government, and over which the local Government has no control. The Rhodesian farmers are well aware of the position, and this, no doubt, explains why so many of them are willing to continue with cotton though mostly on a small scale. They are "keeping their hand in" with the crop in order to be ready to extend operations as and when cotton pays them better than their subsidized crops.

Since the first days of responsible government four Governments have been in power, and each in turn has done as much as possible to foster the cotton-growing industry; it is doubtful if any other part of the Empire has done as much, in proportion, as the successive Governments of Southern Rhodesia. The Government of the day, under the leadership of Mr. G. M. Huggins, F.R.C.S., M.P., is fully alive to the advantages of establishing a cotton-growing industry both as a European and as a Native-grown crop. It realizes that in cotton it has a crop well suited to native cultivation as it requires no cash outlay on the part of the native grower, in addition to which it does not compete with, but is complementary to, the cotton grown by Europeans. Practically the entire proceeds of the sales of cotton (about 95 per cent.) are spent internally; the only materials required to be imported are hessian and hoop iron, which cost approximately 10s. on a bale worth anything from £10 to £12.

This year, by Act of Parliament, the Government has created a Board, known as the Cotton Research and Industry Board, which is charged with the responsibility of doing everything in its power to further the cotton-growing industry. The composition of the Board is as follows: Two members nominated by the Government; one member nominated by the British Cotton Growing Association; one member nominated by the Empire Cotton Growing Corporation; and a representative of the Cotton Growers, also nominated by the Government. The Cotton Research and Industry Act lays down that the Chairman of the Board has to be the nominee of the Empire Cotton Growing Corporation.

The idea underlying the formation of the Board is to give it greater flexibility in operation than is possible in the case of a Government Department, which could not be expected to deal with the financial intricacies involved in the purchase, collection, ginning and marketing of cotton, especially native-grown cotton. It may be argued that the development of the commercial side of the industry should be left to commercial interests, but it is unlikely that any commercial venture would undertake the work until such time as there is sufficient cotton grown to justify the initial capital outlay which would be involved.

The research side of the Board's operations, plant breeding, insect pest control, and other investigational work, will be carried on, as in the past, by the Staff of the Empire Cotton Growing Corporation, aided by generous grants from the Government and the Corporation.

It would be interesting, if it were possible, to give the point of view of the potential native cotton grower, but this, unfortunately, cannot be done. It may be said, however, that the native is conservative, and disinclined to grow anything but food crops. On the whole he is suspicious, and who can blame him? In the past he has been let down by well-meaning but misdirected enthusiasm, he was given seed and told to grow cotton, which he did, but there was no organization for ginning and marketing his crop. He has a long memory, and it will take a lot of patient, uphill work to overcome his prejudice. Those who are best acquainted with the native and his ways believe that, in time, he will react favourably to cotton growing, provided he is given a square deal and paid out in cash. That he will get both is now assured, and whether or not he will take kindly to the crop remains to be seen.

What has been written is an attempt to present some aspects which have a bearing on the future of the cotton-growing industry in Southern Rhodesia. Previous attempts at cotton growing have started and failed. The present position is that an industry has been started and maintained in spite of unforeseen difficulties, and competition from other and subsidized crops. Looking at it from an Imperial point of view, a nucleus has been established in a part of the Empire which very definitely can grow cotton if and when urgently required. That yields are not higher is due, principally, to one pest, the American bollworm. Although, as yet, this pest has not been overcome, much detailed information has been collected patiently and systematically over a number of years—information which will undoubtedly be of use to investigators in this and other countries and which will lead, sooner or later, to a solution of this particular problem.

Improved strains of cotton have been built up, and some of these have found favour outside their country of origin. Contacts have been made with Governments, farming organizations, and other bodies, and the confidence which they have all along shown in the work of the Empire Cotton Growing Corporation has been sustained. Native cotton production is a new development, the outcome of which cannot as yet be foretold.

Reviewing the past, and endeavouring to peer into the future, one sometimes asks, " Is it worth while ?" The writer thinks it is.

Received November, 1936.

THE PEST AND THE PLANT

BY

A. G. BEBBINGTON
Empire Cotton Growing Corporation

AND

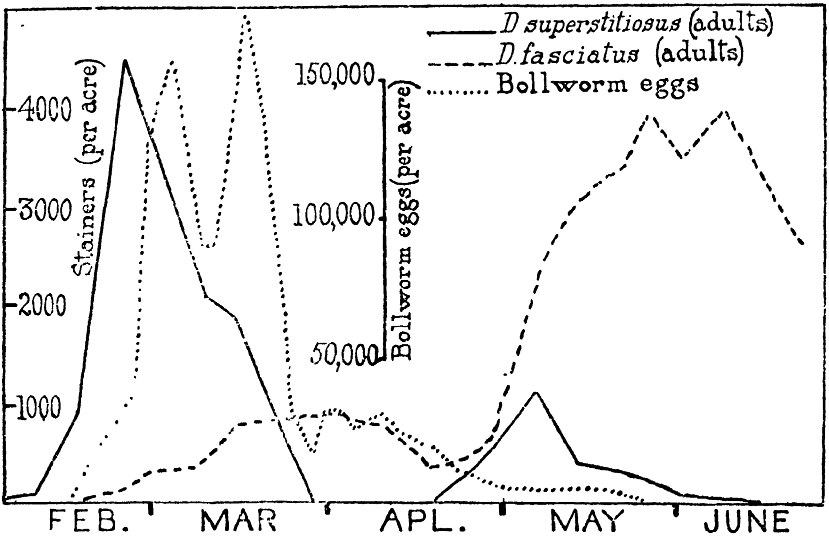
W. ALLAN
Department of Agriculture, Northern Rhodesia.

We have been asked to make, from our comparatively limited experience, some comments on Sir Albert Howard's stimulating and original summary of his views on the rôle of insects and fungi in agriculture. His final conclusion that " Insects and fungi are not the real cause of plant diseases and only attack unsuitable varieties or crops improperly grown," may be true to a very large extent, but we find difficulty in accepting it unreservedly. In the case of the cotton crop we have come to recognize certain insects and diseases, notably a leaf miner and several leaf spots, as very reliable indicators of an unhealthy plant growing under unsuitable conditions, while jassid may cause quite serious damage even to the most resistant strains if they are improperly grown. Two groups of pests, however, the stainers and the American bollworm, appear to provide exceptions to Sir Albert's rule.

When we came to Northern Rhodesia the European farmer had given up cotton growing in consequence of a series of rather dramatic crop failures, and one or two attempts to introduce the crop to the native had been unsuccessful. These failures were attributed to jassid damage, and the introduction of resistant strains from Barberton overcame this difficulty, but we are still unable to grow the crop in the European farming areas with any reasonable assurance of success. There seemed to be nothing very wrong with the climate, with the soil, or with our cultural methods, and from the beginning of the trials all the crops on the Mazabuka Station were grown by ourselves. The plants grew well and set a heavy crop, but very little of this reached maturity—about 4 per cent. according to our extensive ticketing experiment of the 1931-32 season.[1] The analysis of this experiment showed quite clearly that a great part of the crop loss was due to stainer and bollworm. It may be argued that the variety we used was unsuitable in so far as it was subject to severe damage by these pests. Apart from this, the variety U 4, which was adopted as the standard after trials of many others, seems to be well suited to the climatic and other conditions of the country. U 4, in addition to its jassid-resistant qualities, is a hardy and good cropping strain, and therefore shows a marked ability to recover from insect attack. It has proved generally suitable over a large part of Africa, and its failure in some parts of Northern Rhodesia is not so much its fault as its misfortune, since an unlucky combination of circumstances makes it the innocent victim of virulent pest attack throughout the season. The incidence of these insects in the field follows a fairly regular course, though the numbers fluctuate greatly from season to season. The two stainers, *Dysdercus superstitiosus* and *D. fasciatus*, appear at different times and cause their maximum damage to the early and late crop respectively, while bollworm is capable of dealing more or less adequately with anything else. In graph I. we show the number of stainers recorded in the field and the bollworm egg-laying on cotton at Mazabuka in the 1933-34 season. This will give an indication of the general course of events during the growing period of the crop and of the vast insect pest populations which may develop. Some 80 per cent. of the bollworm eggs hatched, and it need hardly be said that the crop was a complete failure. We might, perhaps, have expected to find that attack of stainer and bollworm is less severe on healthy and vigorous plants, but in actual fact the reverse seems to be the case throughout the whole of our experience.

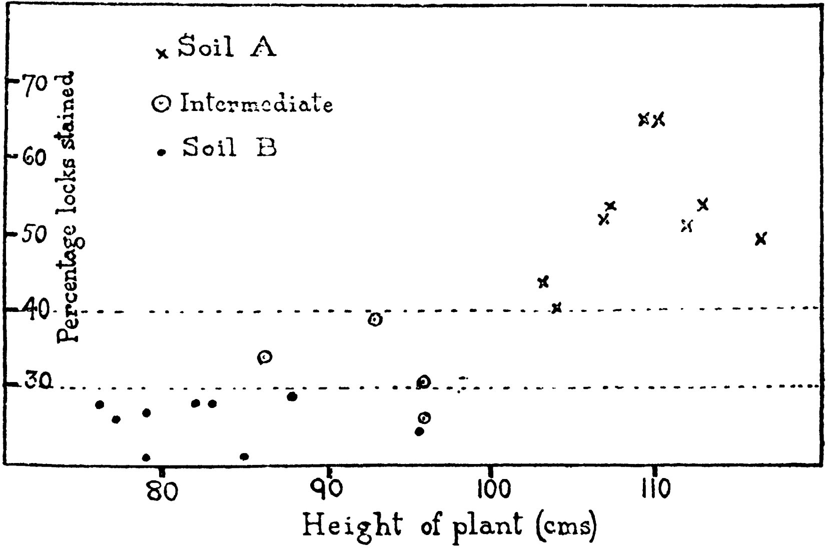
THE EFFECT OF SOIL ON PLANT GROWTH AND STAINER DAMAGE.—The idea that some inverse relation might exist between stainer damage and the growth and vigour of the plant was first brought to our minds when we planted a certain field on the Mazabuka Experiment Station. On this field there are two distinct soil types which can readily be distinguished by eye. The main type is a brown-coloured loam of high fertility (according to local maize standards), while scattered through it there are large patches of a soil lighter in colour and texture. In order to avoid repetition we will call these types A and B respectively. Mr. H. B. Stent, who was then Soil Chemist at Mazabuka, made an analysis of the two types for us, and the main difference he found was that A contained a much higher percentage of organic carbon and nitrogen, probably on account of greater micro-organic activity. The effect of this difference was apparent in the growth of maize and cotton. In one year when the whole field was planted with maize we harvested a large range of samples covering both soil types, and found that

I.

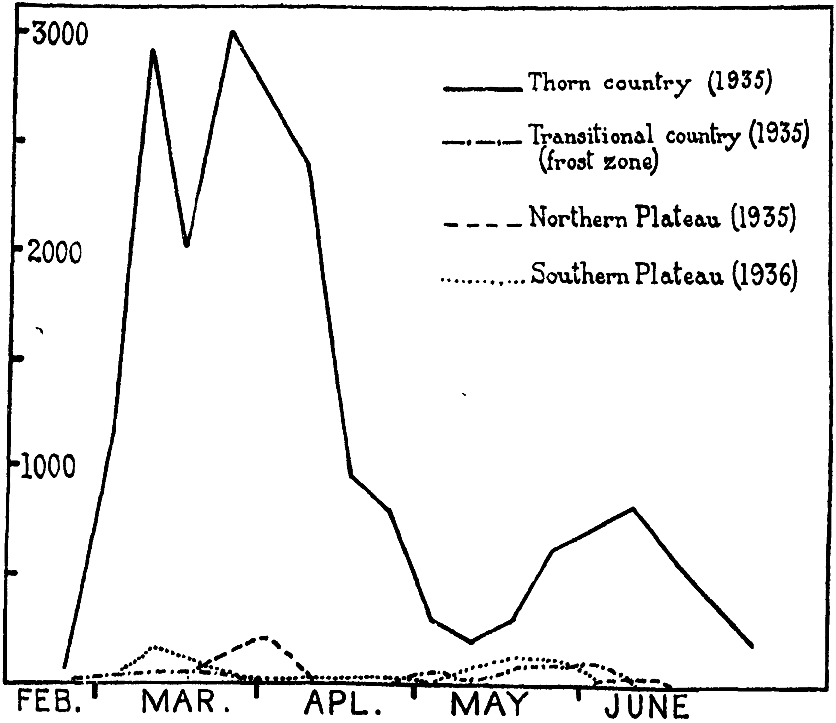


Pest attack on cotton at Mazabuka, 1934.

II.



III.



Comparative numbers of *D. Superstitiosus* on cotton,
(Adults per acre)

the yield of grain from A was 20 per cent. higher than that from B. On soil A cotton plants grew more rapidly, flowered more freely and, according to our ticketing experiment, set much more crop. We may therefore accept A as being the better agricultural soil of the two, and we should expect cotton on this soil to grow better, to yield more and perhaps to suffer less from insect pests. At the end of the first season, when stainer attacks had been severe, the results were very striking, but completely at variance with what we might have expected. The plants on soil B gave a yield three times greater than those on A, and the clean white cotton on the B patches stood out in sharp contrast with the small, badly stained crop on the better soil.[2]

In the following season, when the pest attack was comparatively light, the yields from the two soil types were very nearly the same, in spite of the much heavier crop set on A soil. In this season we made an extensive experiment, ticketing a great number of squares and following their history, while we also made comparative counts of stainer population on the two soil types. Here are figures for one strain showing the average amount of crop set per plant, the amount of shedding, and the number of bolls which remained on the plant at picking time in a damaged and undamaged condition.

			Mature Bolls.	
Soil Type.	*Crop Set.*	*Crop Shed.*	*Damaged by Insects.*	*Undamaged.*
A	55	40	8	7
B	32	21	5	6

Of the 40 squares and bolls shed by the A plants 23 could be quite definitely attributed to bollworm and stainer damage, and of the 21 shed by the B plants 11 came within this category. Our estimate of the proportion of shedding due to insects is probably low because very often shed bolls were so rotted that it was impossible to diagnose the cause with certainty, and such shedding was put in the category of "unknown causes." It would seem, then, that the amount of crop shed on account of insect damage was twice as great on the A soil, and this figure, which applies equally to stainer and bollworm, makes an interesting comparison with the stainer counts. We found that the total stainer population on the plants growing on soil A was almost precisely twice as great as the population recorded on the B samples. The mature crop on the A plants was also more severely stained, and indeed there appears to be some measure of correlation between the development of the plant as measured by its height and the amount of staining. Height measurements and counts of the percentage of stained locks were made on a number of small plots on each soil type.[1] The mean figures for these plots are shown on graph II., and it will be seen that the percentage of staining was twice as great on the A plants, the mean percentage staining for all samples being 26 for B plots, 32 for plots on intermediate soil, and 53 for A plots. Here, then, we have a case where the healthier plants on the better soil have suffered more severely from insect damage, although all of the plants were grown under precisely the same cultural conditions. A similar relation seems to exist in the case of bollworm. It has been shown by Parsons and Ullyett[3] that egg-laying of the American bollworm is very irregular over a field and is directly correlated with the height and vigour of the plants, few or no eggs being laid on unhealthy plants such as those suffering from " stripe " disease. Our own records at Mazabuka agree with those of Parsons.

THE SEASONAL VARIATION IN INSECT POPULATION.—The numbers in which such pests as stainer and bollworm appear in cotton varies markedly from year to year, and there is no apparent association between these fluctuations and the health of the plant. The heaviest pest attacks do not necessarily occur in the seasons least favourable for the growth of the crop—indeed, the heaviest pest attack we have recorded occurred in the season climatically most favourable to the crop. What then determines these fluctuations? We can give a partial answer to this question in the case of the stainer *D. fasciatus*. Within the region of our investigations (that is, a considerable area of North-Western Rhodesia), the chief host plant of this stainer is the small tree *Thespesia rogersii*. We have, for Mazabuka, a series of records which now cover five years and include not only stainer population on *T. rogersii* but also flowering, fruit-opening, leafing and leaf-shedding. In addition, we have similar records covering from one to three years for five other areas. When these records are plotted and compared with corresponding populations of *D. fasciatus* on cotton they tell the same story in every case.[4] The number of stainers which migrate to cotton is determined by the condition of the host rather than by the condition of the crop. Early in the year, when much of the old fruit on the trees has rotted and shed before the new crop opens, there is usually a period when the stainer is short of food. If this occurs, the trees become centres from which hungry stainers radiate and wander in search of food, and their wanderings take them to cotton when the crop can supply their needs and when they can cause considerable damage. It would seem that the period of food shortage and the consequent movement to cotton occurs in most years, but we have two perfectly clear records of seasons when it did not occur. These seasons were characterized by abundant flowering of *Thespesia* and by the appearance in comparatively small numbers of a certain caterpillar which destroys the early crop on the tree. Consequently the new fruit began to open before the stainer population bred on the old fruit had reached its limit and there was no period of food scarcity.* In both of these seasons the same thing happened: the stainer increase was not checked, enormous numbers were bred up on the trees, and not a single stainer of the species appeared in cotton until most of the crop had been picked. Here then is a fairly clear picture of a mechanism which determines the incidence of one pest species on cotton, and we see that the numbers in which the species appears in the crop and the time of the attack is dependent upon the condition of the wild host rather than on the condition of the crop.

VARIATION IN INSECT ATTACK IN DIFFERENT REGIONS.—The host relation of *D. fasciatus* is comparatively simple, but in the case of our other stainer, *D. superstitiosus*, the host relation is more complicated because this species depends on a sequence of short-lived plants which differ in various regions. Also the climatic conditions of the dry season appear to have a direct lethal effect on the species, and it seems to die out over large areas which become repopulated during the rains by migrations from comparatively distant sources. We are beginning to get some kind of picture of these migrations and of the food sequences in different vegetative regions, but the picture is still rather like an imperfectly developed and somewhat fogged negative. One thing which does stand out clearly, however, is the great difference in the attack on cotton in these different regions. It is not, however, in the regions of good soils or of more suitable climatic conditions that the attack is least, it is on the poorer soils and in the frost regions. In this case it is not simply an attraction of the stainer to the more vigorous plants, such as we find within the limits of a single field, the difference as in the case of *D. fasciatus* seems to be determined by the host relations. The section of country for which we have some sort of picture is about 150 miles from north to south and about 100 miles from east to west. *D. superstitiosus* appears to be generally distributed over this area at the end of the wet season, feeding on different hosts in the different vegetative regions. During the dry season the species rapidly disappears, and in October we have so far found it only in a few small areas where the distribution of certain hosts and of eco-climatic conditions favouring development coincide. Here the species breeds rapidly during the warm months of the late dry season, and from these foci it spreads out after the rains have set in and generally favourable climatic conditions have been re-established. These stainers, of what we may call the first generation from the dry season foci, seem to migrate considerable distances. They appear in the grassland and the thorn belt country of the Mazabuka district shortly after the first rains, and there they breed on a small short-lived plant which is very abundant on the alluvial soil. One generation is bred on this plant and is forced to migrate almost as soon as it matures by the drying up of the host. This migration is taking place just when cotton is flowering and beginning to fruit. Now within the thorn country there is a discontinuous host sequence—that is to say, there is a period when there are no attractive food plants in a flowering or fruiting stage. This period begins with the drying up of the first early flowering host, and lasts from four to six weeks during February and March. Cotton, as it so happens, fits very nicely into this gap in the host sequence and consequently it is subject to very heavy attacks. In the other regions, however, the gap in the host sequence does not occur. In each case there are host plants of different kinds which flower just before cotton and which are sufficiently abundant and attractive to divert the stainer from the crop. The stainer population on these wild hosts does, in fact, become very great, but the attack on cotton is comparatively light. Graph III. gives a clear picture of the stainer attacks on cotton which we have recorded in different districts. Nor within the limits of a single region are there any indications that the more neglected fields are more severely attacked by *D. superstitiosus*. Figures are given on p. 39 for four native-grown plots used for recording stainer attacks on the southern plateau in the 1935-36 season.

---

* Since we wrote this article we have read Dr. Willis's editorial in the last number of the Review and we were struck by his reference to the freedom of the plant in its natural state from pests and diseases. Here again our experience seems to have been unfortunate, as the Northern Rhodesia bush is scarcely a good example of such immunity. The variety of galls, witchbrooms, leaf-spots, defoliating caterpillars and the like is astonishing. The crop destruction of *Thespesia* to which we refer is a good example of the way in which insects may attack a plant in its natural state. *Thespesia*, like cotton, has its bollworm and stainer attacks, which are usually sufficiently severe to destroy all but a small proportion of the crop, though the remaining fraction is sufficient to enable the plant to maintain itself and even to increase. In the same way the amount of fruit surviving on the cotton plant would be sufficient to enable it to increase, but not enough to provide a commercial crop.

The yields reflect precisely the amount of attention given to the plots by the growers. The first was well cultivated, the last practically abandoned, and three but indifferently tended. Yet it is on the best plot that stainers appear in greatest numbers, though even here the attack was of short duration. The numbers in which *D. fasciatus* appears in cotton also vary in different regions, and the variation appears to be associated with the distribution of the tree host of this species. *Thespesia* is most abundant in the thorn country where the maximum attacks have been recorded. It is comparatively rare on the plateau where the corresponding attacks have been less severe.

Yield Seed Cotton in Lbs. Per Acre.	D. Superstitiosus—*Max. Number Recorded Per Acre.*
506	700
224	—
210	140
208	160
80	60

Insect Damage and other Factors.—We feel that Sir Albert visualizes the whole population of insect pests and disease organisms lying in wait, as it were, to pounce upon the weakling plant. We hope, however, that we have produced sufficient argument to show that this is not invariably the case.

So far as we can see the attack of stainers on a cotton plot is determined by two broad principles:

(*a*) The actual number of stainers that go to the crop is determined by the state and sequence of the wild hosts, and cotton should be regarded merely as a potential link in the sequence.

(*b*) The distribution of the stainer population over one crop is determined by the state and growth of the plants, but it is the most vigorous, healthy and best fruiting plants that suffer most. Further, so far as our scanty records go, we believe that this is also the case with American bollworm.

While our experience has forced us to the view that insect damage may be a distinct and very important factor where cotton is concerned, we are now becoming painfully acquainted with other limiting factors of equal importance. On the looser types of Kalahari sand soils, which are theoretically ideal as regards freedom from stainer, the plant will not grow. In some of the upland areas early frost may be a limiting factor. In the lower valley regions of the Zambesi, where prolonged droughts are frequent, climatic conditions may be unsuitable. In a certain region of the transitional Kalahari sand a new pest, the giant cricket, has caused havoc. It would seem that the cricket damage can be avoided by early planting. If this is the case, have we found a true scientific solution by improving cultural methods, or are we practising the altogether unsatisfactory expedient of mere evasion? In leaving the areas of heavy pest attack, are we practising this same expedient ?

Sir Albert's dictum, while it contains much truth, does not seem to be an altogether safe guide for ordinary practice because, sad though it may be, the world depends to a large extent on crops improperly grown. If he had been able to introduce the bollworm and the weevil into India they might have found his cultures poor nourishment, though we have some doubts on this point, but there can be little doubt as to the effect on the commercial crop of India. In some measure this "improper" stage of agriculture must continue, for the amount of care given to a crop will be determined by the cash return and this, like all the other factors of production, is subject to the law of diminishing returns. Pliny possibly had some such thought in mind when he deprecated the excessively high standards of cultivation practised by the "gentlemen farmers" of the early Empire. "Are we of opinion, then, that ruin and starvation must be the necessary consequence of such a course as this? Yes, by Hercules! and the very best plan of all is to let moderation guide our judgment in all things. To cultivate land well is absolutely necessary, but to cultivate it in the very highest style is mere extravagance.'

REFERENCES

1. Bebbington, A. G., and Allan, W. (1931-32). "Reports from Experiment Stations, E.C.G.C."
2. Bebbington, A. G., and Allan, W. (1930-31). "Reports from Experiment Stations, E.C.G.C."
3. Parsons, F. S., and Ullyett, G. C. "Investigations on the Control of American and Red Bollworms of Cotton in South Africa." *Bull. Ent. Res.*, xxv., 3, September, 1934.
4. Bebbington, A. G., and Allan, W. "The Food Cycle of *D. fasciatus* in Acacia Savannah in Northern Rhodesia." *Bull. Ent. Res.*, xxvii., 2, July, 1936.

Received November, 1936.

EARLY DAYS OF COTTON GROWING IN THE U.S.A.

[In a paper read to the Manchester Literary and Philosophical Society on February 20, 1830, Mr. John Kennedy, one of the two founders of the firm of McConnel and Co. Ltd. (a branch of the Fine Spinners' Association), included the following letter to the *Charleston (South Carolina) Courier*, premising that the information was supplied in consequence of a notice which he had caused to be inserted in the Charleston newspapers.—Ed.]

" Sir,

There has been for some months past a notification in your paper requesting a communication upon the subject of the introduction of cotton into Georgia and Carolina.

It has been intimated to me that possibly this notification has originated in some one desirous of correct information, in order that it might enter into some more general work; and, as I am at present perhaps the only person alive that recollects distinctly the introduction of the Sea Island cotton, I have addressed this letter to you.

It is known to many that cotton was cultivated for domestic purposes from Virginia to Georgia long anterior to the revolutionary war. Mr. Jefferson speaks of it in his Notes on Virginia. Bartram speaks of it in his Travels as growing in Georgia, and I have understood that twenty-two acres were cultivated by a Colonel Dellegal upon a small island near Savannah before the revolution, but this was the green seed or short staple cotton. Two species of the same family then existed in this country—the real green seed, and a low cotton resembling it in blossom—both being of a pale yellow approaching to white; one with the seed covered with fuzz, the other with fuzz only upon the end of the seed. To explore the first introduction of the short staple cotton into this country would now, in all probability, be impossible, but we may very well suppose it was by one of the southern proprietary governments, and possibly from Turkey, the trade of which country with England was then of much higher consideration than it has subsequently become. Nor would it have escaped those proprietors, many of whom were enlightened men, that the climate of Asia Minor, where cotton grew abundantly, was analogous to the climate of the provinces south of Virginia.

Just about the commencement of the revolutionary war Sir Richard Arkwright had invented the spinning jenny, and cotton spinning became a matter of deep interest. In England cotton rose much in price, its various qualities attracted notice, and the world was searched for the finer kinds. The Island of Bourbon was alone found to produce them, and yet the Bourbon cotton greatly resembled in its growth our green seed cotton, although it cannot be its parent plant, for all attempts to naturalise it in Georgia (which were many and repeated) have failed. It gave blossoms, but it was cut off by the frost in the fruit. Nor would it ratoon, or grow from the root, the next year—in which, too, it resembles the green seed cotton of our country. This is all I am able to say, and perhaps all that is necessary to be said, of the short staple cotton.

The Sea Island cotton was introduced directly from the Bahama Islands into Georgia. The revolutionary war that closed in 1783 had been a war not less of opinion and of feeling than of interest, and had torn asunder many of the relations of life, whether of blood or of friendship. England offered to the unhappy settlers of this country, who had followed her standard, a home in but two of her provinces. To the provincials of the north she offered Nova Scotia, to the provincials of the south the Bahama Islands. Many of the former inhabitants of the Carolinas and Georgia passed over from Florida to the Bahamas with their slaves. But what could they cultivate ? The rocky and arid soil of those islands could not grow sugar-cane; coffee would grow, but produced no fruit. There was one plant that would grow, and that bore abundantly—it was cotton. The seed, as I have been often informed by respectable gentlemen from the Bahamas, was in the first instance procured from a small island in the West Indies, celebrated for its cotton, called Anguilla. It was therefore long after its introduction into this country called Anguilla seed.

Cotton, as I have already stated, had taken a new value by the introduction of the spinning machine into England. The quality of the Bahama cotton was then considered among the best grown. New life and hope were imparted to a colony and a people with whom new hope itself had been almost extinct. This first success, as is natural to the human mind under whatever influence it may act, recalled the memory of the friends they had left behind them. The winter of 1786 brought several parcels of cotton seed from the Bahamas to Georgia; among them (in distinct remembrance upon my mind) was a parcel to the Governor Tatnall of Georgia from a near relation of his, then Surveyor-General of the Bahamas; and another parcel at the same time was transmitted by Colonel Roger Kelsall of Exuma, who was among the first, if not the very first, successful growers of cotton, to my father, Mr. James Spalding, then residing on St. Simon's Island, Georgia, who had been connected in business with Colonel Kelsall before the revolution. I have heard that Governor Tatnall, then a young man, gave his seed to Mr. Nicholas Turnbull, lately deceased, who cultivated it from that period successfully.

I know my father planted his cotton seed in the spring of 1787 upon the banks of a small rice field of St. Simon's Island. The land was rich and warm, the cotton grew large and blossomed, but did not ripen to fruit; it, however, ratooned, or grew from the roots the following year. The difficulty was now over, the cotton adapted itself to the climate, and every successive year from 1787 saw the long staple cotton extending itself along the shores of Georgia and into South Carolina, where an enlightened population, then engaged in the cultivation of indigo, readily adopted it.

All the varieties of the long staple, or at least the germ of those varieties, came from that seed; differences of soil developed them, and differences of local situations are developing them every day. The same cotton seed planted on one field will give quite a black and naked seed, while the same seed planted upon another field, different in soil and situation, will be prone to run into large cotton, with long boles or pods, and with seed tufted at the ends with fuzz. I should have great doubts if there is any real difference in these apparent varieties of the long staple cotton. But if there is, all who observe must know that plants, when they have once intermingled their varieties, will require attention for a long series of years to disentangle them.

Subsequently to 1787, as the cultivation of cotton extended and became profitable, every variety of the cotton that could be gleaned from the four quarters of the globe has been tried, but none of them but one has resulted in anything useful. Mr. James Hamilton, who formerly resided in Charleston, and who now resides in Philadelphia, was indefatigable in procuring seed, which he transmitted to his friend Mr. Couper of St. Simon's. Mr Couper planted some acres of Bourbon cotton; it grew and blossomed, but did not ripen its fruit, and perished in the winter.

Mr. Hamilton sent a cotton from Siam; it grew large, was of a rich purple colour both in foliage and blossom, but perished also without ripening its fruits.

The Nankeen cotton was introduced at an early period, the same that Mr. Secretary Crawford distributed the seed of some years back. It was abundant in produce, the seed fuzzy, and the wool of a dirty yellow colour, which would not bring above the price of the other short staple cottons, but I know it to produce three hundredweight to the acre on Teykel Island in Georgia.

The kidney seed cotton, that is a cotton which produces the seed all clustered together, with a long strong staple extending from one side of the seeds, and which I believe to be the Brazilian, or Pernambuco cotton, was tried, and was the only new species upon which there could have been any hesitation, but this, too, was given up because not as valuable and not as productive.

I have given the names of gentlemen because I had no other means of establishing facts, and now my communication shall close.

Your very obedient Servant,
THOMAS SPALDING."

DARIEN, GEORGIA.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

World's Crops.—The feature of this table again is, as it has been now for several years, the unparalleled increase of Outside Growths both absolutely and relatively to American. In 1934 and 1935, owing to very small American crops, Outside Growths, which were steadily increasing all the time, exceeded 58 per cent. of the World's total (including linters), but in 1936, in spite of the fact that the American crop has returned to something like normal figures, the increase of Outside Growths, judging by the tentative figures already available, is likely to result in an almost as high percentage.

The result is that the World's total for 1936-37 bids fair to be a new record at just over 32 million bales. The previous record was 30,153,000 bales in 1926, but that consisted of 19,135,000 bales of American (including linters) and only 11,018,000 bales of Outside Growths. This season is likely to show a transfer of about seven million bales from the one item to the other.

The distribution of this enormous total of nearly 18½ million bales of Outside Growths is very wide. India again promises a good crop, while China, Russia and Egypt among the major crops, and many of the smaller ones, are promising new records. In some cases, of course, our tentative estimates are merely repetitions of last year's figure or intelligent guesses, but subsequent revisions are not likely to affect the total seriously. Recently at least revision has always increased the totals.

American Crop.—The experience of the Bureau Reports this season has been most unhappy. Beginning with the unexpectedly high figure of 12,481,000 bales in August, this was reduced at one fell swoop to 11,121,000 bales in September, only to be raised again to 11,609,000 bales in October and 12,400,000 bales in November. In December, however, when a further heavy revision involving increased acreage figures was expected, the actual increase was only 334,000 acres left for harvest, and this was offset by a reduction of the acreage yield so that the crop estimate was only increased to 12,407,000 bales.

Egyptian Crop.—In the October issue only the details of acreage for 1936 were available. The Government's first crop estimate, issued later in that month, more than confirmed the reports of the favourable progress the crop had made, in spite of a very heavy attack of cotton worm especially in Upper Egypt, by promising a new record crop of 9,184,000 kantars excluding Scarto, and for the first time for many years this is almost exactly the same as the first estimate put forward by the authorities of the Alexandria Bourse, 9,180,000 kantars. On the comparatively small area figures of this season that means a new record average yield for every variety.

Egyptian Carryover.—Our next table gives the World's Carryover of Egyptian cotton, and the main point is the further reduction of the Carryover at the end of the season from last July, which makes the figure the smallest in our table. The strength of the statistical position in Egyptian is not likely to be seriously affected by the prospective larger crop, for last season's consumption, as has been noted, was just over 9 million kantars, and this year's crop is not likely to be *much* more than that.

World's Consumption.—The Federation's final details of the consumption for the second half of last season made so little difference in the preliminary figures given in the October issue that there would be little point in repeating the table. The only change of any interest is that it raises the Egyptian total to 1,202,000 bales, which just makes it a new record.

There is still no better information available as to the German and Italian figures, for which we were reduced in the October issue to repeating the U.S. estimate for Germany in 1934-35 and the Federation figures for Italy. Garside, however, has now raised his preliminary estimates of the World's total figures to something nearer the Federation's figures, and we therefore give a table comparing his figures with those of the Federation for the last six seasons, dividing Garside's figures for American between U.S.A. and Other Countries.

In order to get some idea of how far the discrepancy is due to Germany and Italy, we also give a small table showing Garside's figures for Germany last year against the U.S. estimate, and his figures for Italy this year against his own and the Federation's figures last year. These figures seem to indicate that Garside is still on the low side for Germany, but that we are too high for Italy.

To the first Consumption table on page 50 we are able to add Garside's estimates for the World Consumption both of American and of Outside Growths for the first three months of the new season, and these are rather serious, for they show that while consumption in the U.S.A. is running very high, the consumption of American in other countries is falling off very badly, while the consumption of Outside Growths is steadily increasing. America, of course, uses very little but her own cotton.

Certainly the figures of Consumption in the U.S.A. given in the third table on page 50 are very striking. Both September and October were records for their respective months. To find a higher figure in any month we have to go back to June, 1933 (697,261 bales), which was the record for any month in history. That was due to inflation in America and a rush to get orders through before the Processing Tax came into effect.

Prices.—The table of futures prices reflects to some extent as regards American the varying fortunes of supply as shown by the Bureau Reports. The main feature, however, of September and October was the constant pressure of hedging owing to the very rapid movement of the crop, but with the first week of November this movement was at last checked. The pressure, however, was well supported owing to the heavy consumption in the United States.

As regards Egyptian the Sakel position in Liverpool is becoming more and more artificial, and it is clear that for the remaining months of its life the Liverpool Sakel contract will simply provide a market for " rigging " purposes. An important factor in the position is the report that this season's Sakel is of inferior quality and likely to lead to further rejections. There is no room in this table to include the new Giza 7 contract which came in on October 1. The price movements of the new contract so far have been very irregular, following neither those of Sakel nor those of Uppers, and it is very difficult yet to say how the new contract is going to settle down. The latest development is the introduction of a Giza 7 contract in Alexandria.

The movements of spot prices which are given in our last table have been rather irregular since August, but the percentage prices of most of the varieties increased up to October, with Uppers a definite exception and Sakel showing, as in the case of futures, the most marked rise of all. In November the irregularity was still more marked, Uppers and Sakel touching new high levels.

WORLD'S COTTON CROPS.

(Bales of 500 Lbs.—000's.)

	1931-32.	1932-33.	1933-34.	1934-35.	1935-36.	1936-37.
U.S.A. Lint	17,096	13,002	13,047	9,637	10,638	12,407
Linters	1,067	912	982	1,001	1,100	1,100
Total	18,163	13,914	14,029	10,638	11,738	13,507
Mexico	203	99	255	223	235	348
Brazil	575	438	958	1,309	1,743	1,470
Peru	228	237	278	336	342	345
Argentine	165	146	196	295	354	400
Other South American	46	39	76	70	90	90
India*	4,007	4,656	5,108	4,858	5,728	5,700
China	1,733	2,195	2,652	3,001	2,322	3,650
Japan, Korea, etc. ...	99	133	197	224	230	275
East Indies, etc. ...	15	13	15	16	16	16
Russia	1,846	1,776	1,917	1,744	2,430	3,040
Persia	107	79	137	200	120	120
Iraq, Ceylon, etc. ...	1	†	†	2	4	4
Asia Minor and Europe	131	68	203	263	384	404
Egypt	1,271	991	1,715	1,511	1,707	1,889
Sudan	188	110	126	237	193	190
East Africa (British)	182	269	274	273	328	328
South Africa (British)	3	2	3	3	4	4
West Africa (British)...	5	20	23	47	40	40
Non-British Africa ...	96	121	154	165	165	165
West Indies (British)...	2	2	3	4	4	4
West Indies (Others) ...	31	26	23	33	23	23
Australia, etc.	4	11	18	14	16	16
World's Total ...	29,101	25,345	28,360	25,466	28,216	32,028
Outside Growths ...	10,938	11,431	14,331	14,828	16,478	18,521
Per cent. on Total ...	37·6	45·1	50·5	58·2	58·5	57·8

* Government estimate, 400 lb. bales. † Less than 500 bales.

AMERICAN CROP (EXCLUDING LINTERS).

	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.	1935-36.
Acreage planted (000's)	43,329	39,110	36,494	40,248	27,860	27,888
Acreage harvested ...	42,444	38,704	35,891	29,383*	26,866	27,335
Crop (running bales)...	13,756	16,629	12,710	12,664	9,472	10,420
Yield per acre (lbs.) ...	157·1	211·5	173·5	212·7	171·6	186·3
Season's average spot price (Liverpool—pence per lb.) ...	5·71	4·82	5·62	6·02	6·93	—

Progress of the Season 1936-37.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	30,621	30,621	30,621	30,621	30,932	—
Acreage harvested ...	29,924	29,720	29,720	29,720	30,054	—
Crop (500 lb. bales) ...	12,481	11,121	11,609	12.400	12,407	—
Yield per acre (lbs.)...	199·7	179·2	186·9	199·7	197·6	—

Less 10,396,000 acres special abandonment.

EGYPTIAN CROP.

	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.
Area (feddans, 000's) ...	1,683	1,094	1,804	1,732	1,669	1,716
Crop (kantars, 000's):						
Alexandria adjusted arrivals	6,563	5,050	8,438	7,540	8,375	9,210†
Government figures*	6,357	4,956	8,575	7,556	8,535	9,446†
Average yield (kantars per feddan)*	3·78	4·53	4·75	4·36	5·11	5·51†

Season's Average Spot Prices (Liverpool—Pence per Lb.).

Sakel	6·80	7·79	8·05	8 52	9·22	—
Percentage on American	41·1	38·6	33·7	22·9	41·4	—
Uppers	5·68	7·01	6·64	7·57	7·48	—
Percentage on American	17·8	24·7	10·3	9·2	11·7	—

* Final revised figures, including Scarto.
† December estimates.

WORLD'S CARRYOVER OF *EGYPTIAN* COTTON.

(KANTARS 000's.)

End of	*Stock and Afloat.*		*U.S.A.*		*Alexandria.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.**
	U.K.	*Continent.*	*Mills.*	*Warehouses.*				
1929, July ...	510	150	449	197	1,677	2,983	1,260	4,243
1930, January	*585*	*270*	*353*	*202*	*3,403*	*4,813*	*1,335*	*6.148*
July ...	353	135	483	245	3,616	4.832	1,297	6,129
1931, January	*630*	*293*	*341*	*129*	*5,349*	*6,742*	*1,185*	*7,927*
July ...	600	165	212	108	4,452	5,541	1,418	6,959
1932, January	*1,013*	*248*	*145*	*63*	*5,521*	*6,990*	*1,447*	*8.437*
July ...	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	*878*	*218*	*134*	*171*	*4,255*	*5,656*	*1,425*	*7,081*
July ...	742	202	131	143	2,228	3,446	1,635	5,081
1934, January	*1,507*	*337*	*142*	*106*	*3,157*	*5,249*	*1,687*	*6,936*
July ...	1,132	248	174	135	1,491	3,180	1,868	5.048
1935, January	968	435	132	100	2,230	3,865	*2,242*	*6,107*
July ...	533	285	130	110	546	1,604	1,965	3.569
1936, January	690	383	98	87	2,368	3,626	*2,078*	*5,704*
February	750	233	107	92	2,241	3,423	—	—
March	728	345	112	97	2,149	3,431	—	—
April ...	630	308	111	103	1,913	3,065	—	—
May ...	600	293	117	100	1,567	2,677	—	—
June ...	518	307	137	85	988	2,035	--	—
July ...	420	233	129	81	619	1,482	1,927	3,409
August	375	158	129	86	489	1,237	—	—
September	338	135	123	76	1,307	1,979	—	—
October	473	247	118	65	2,198	3,101	—	—

* Figures in *italics* to distinguish between mid-season and end of season.

WORLD'S COTTON CONSUMPTION.

AMERICAN v. OUTSIDE GROWTHS—GARSIDE v. FEDERATION.

(RUNNING BALES, 000'S.)

	Garside.					*Federation.*		
	American.							
	U.S.A.	*Other Countries.*	*Total.*	*Outside Growths.*	*All Kinds.*	*American.*	*Outside Growths.*	*All Kinds.*
1930–31	5,084	5,972	11,056	11,371	22,427	10,901	11,580	22,481
1931–32	4,744	7,784	12,528	10,353	22,881	12,316	10,003	22,319
1932–33	6,004	8,381	14,385	10,265	24,650	14,171	10,182	24,353
1933–34	5,553	8,227	13,780	11,816	25,596	13,534	11,577	25,111
1934–35	5,241	5,965	11,206	14,119	25,325	11,354	14,447	25,801
1935–36	6,221	6,318	12,539	15,190	27,729	12,764	14,789	27,553
1936–37.								
August	562	415	977	1,270	2,247	—	—	—
September	615	372	987	1,324	2,311	—	—	—
October	633	393	1,026	1,403	2,429	—	—	—
1st Quarter.	1,810	1,180	2,990	3,997	6,987	—	—	—

ESTIMATES FOR GERMANY AND ITALY.

	1934–35.			1935–36.		
	American.	*O.G.*	*Total.*	*American.*	*O.G.*	*Total.*
Germany : Garside	376	568	944	390	753	1,143
„ U.S. Estimate	485	882	1,367	—	—	—
Italy : Garside	460	346	806	425	203	628
„ Federation	455	333	788	—	—	—

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(RUNNING BALES 000'S: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1934–35.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
February ...	478·3	24·2	467·1	0·7	7·3	3·1	62·8
March ...	481·1	22·9	469·6	0·8	6·9	3·8	66·8
April ...	462·8	21·3	450·8	1·1	6·8	4·1	70·3
May ...	469·2	20·6	458·8	1·4	5·7	3·4	65·5
June ...	385·9	19·3	376·8	1·3	4·6	3·2	61·9
July ...	391·8	17·8	382·0	1·3	4·7	3·8	62·1
1935–36.							
August ...	408·4	18·6	397·9	2·0	4·7	3·9	57·9
September ...	449·1	21·4	437·6	1·8	5·5	4·2	61·1
October ...	552·2	24·0	538·5	2·0	6.4	5·3	67·1
November ...	507·8	24·8	496·1	1·8	5·2	4·8	59·5
December ...	498·3	26·2	487·3	1·8	5·5	3·7	55·2
January ...	591·3	26·0	578·1	2·2	6·6	4·4	56·0
February ...	516·6	25·8	504·2	1·9	5·6	5·0	53·6
March ...	548·9	25·0	536·9	1·8	5·0	5·3	60·8
April ...	576·8	26·5	562·7	1·7	5·8	6·6	61·4
May ...	530·8	25·3	518·3	1·4	5·2	5·9	64·7
June ...	556·3	25.3	542·8	1·4	5·3	6·9	64·0
July ...	603·2	26·2	588·3	1·8	6·1	7·0	70·2
1936–37							
August ...	574·3	27·3	560·3	1·7	5·6	6·7	65·4
September ...	629·7	29·0	613·7	1·7	5·9	8·5	67·9
October ...	646·5	29·7	630·9	1·8	6·0	7·8	72·5

HIGHEST AND LOWEST FUTURES PRICES.

1934-35.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
May ...	12·19	10·95	6·56	6·29	8·16	7·86	7·47	7·16
June ...	11·58	10·76	6·17	*5·74*	7·91	*7·62*	7·03	*6·66*
July ...	11·80	11·30	6·28	6·12	7·89	7·67	7·10	6·97
1935-36.								
August ...	11 60	*10·31*	6·22	5·63	7·86	7·58	7·04	6·42
September	10·81	10·31	5 97	*5·52*	8·01	*7·48*	6·82	*6·38*
October ...	11·27	10·54	6·21	5·77	8·42	7·78	6·87	6·51
November	11·97	10 86	6 54	6·07	9·51	8·44	7 77	6·82
December	11·77	11 01	6·49	6·14	9·20	8·57	7·71	7·28
January ...	11·58	10·90	6·24	5·77	9·22	8·54	7·53	7·03
February	10·99	10·63	5·87	5·62	8·81	8·29	7·14	6·84
March ...	11·34	10.59	6 08	5 66	8 76	8·34	7 20	6 90
April ...	11·31	10 80	6 11	5·83	8·72	8·45	7·18	6·94
May ...	11·58	11·02	6·13	5·93	8·68	8·48	7·30	6·95
June ...	11·79	10 60	6·34	5·79	9·20	8·44	7·45	6·84
July ...	*12·78*	11·51	*6 84*	6·23	*11·04*	9·14	*7·92*	7·35
1936-37.								
August ...	12·16	11·30	6·53	6·10	10·79	9·96	7·49	6·99
September	12·30	11·50	6 68	6·13	10·18	9 67	7·32	6·91
October ...	12·21	11·51	6 78	6·51	10·80	9·93	7·45	7 14
November	11·92	11·51	6·75	6·46	10·91	9·93	7·56	7·17

Maximum and minimum each season in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (Last Friday of Each Month).

1934-35.	*American (Middling). Pence per Lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil.*		*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
				Pernam (Fair).	*San Paulo (Fair).*				
May ...	6·92	77·7	97·1	94·9	97·1	107·2	109·4	109·8	117·9
June ...	6·85	80·0	98·5	96·4	98·5	108·8	109·5	108·2*	117·2
July ...	6·80	81·8	100·0	96·3	98·5	106·6	108·8	108·5	118·7
Season's average	6·93	75·6	98·7	95·5	97·4	108·4	113·6	109·2	122·9
1935-36.									
August ...	6·21	76 0	100·0	95·2	97·6	106·4	108·9	114·2	128·0
September	6·40	78·6	100·0	96·1	98·4	105·5	109·4	112·3	133·1
October ...	6·47	84·7	100·8	98·5	100·8	109·3	117·0	107·3	140·8
November	6 59	87·3	101·8	99·5	101·8	111·7	119·3	120·2	153·9
December	6·41	87·8	101·6	100·0	102·3	114·8	119·5	120·1	148·8
January...	6·14	82·9	101·6	100·0	102·4	113·8	121·2	119·1	157·8
February	6·04	82·3	100·8	99·2	101·7	111·6	121·5	116·9	149·5
March ...	6·44	78 6	100 0	96·9	100·8	110·1	119·4	114·4	142·9
April ...	6·62	76·6	100·0	97·0	100·8	109 8	118·9	112·5	138·2
May ...	6·64	72·6	99·2	94·7	99·2	106·0	118·1	113·6	130·6
June ...	7·18	73·8	98·6	93·0	95·8	104·2	115·3	112·3	128·8
July ...	7·10	79·6	97·9	92·3	94·4	103·5	115·5	126·1	158·2
Season's average	6·52	79·9	100·2	96·8	99·7	108·9	116·6	114·7	141·4
1936-37.									
August ...	6·70	74·0	97·0	91·8	94·0	104·5	117·9	117·3	153·4
September	6·73	76·1	99·3	94·1	96·3	106·7	117·8	109·5	150·8
October ...	6·81	74·0	100·3	95·2	97·4	106·9	123·0	106·5	167·6
November	6·72	75·0	98·8	95·1	97·3	107·7	124·1	109·8	170·4

THE ROLE OF INSECTS AND FUNGI IN AGRICULTURE

The following letter has recently been received by the Editor:

CAMPINAS, BRAZIL,
August, 1936.

DEAR SIR,

In his interesting article, " The Rôle of Insects and Fungi in Agriculture," in the July number of the EMPIRE COTTON GROWING REVIEW, Sir Albert Howard makes the remarkable statement that " Insects and fungi are not the real cause of plant diseases, and only attack unsuitable varieties or crops improperly grown. Their true role in agriculture is that of censors for pointing out the crops which are imperfectly nourished."

While every pathologist or entomologist would agree on the importance of maintaining the health of the plants by every possible means, I think very few would agree that his thesis should be extended to all insects and all fungi. There do seem to be some insects, such as aphides, thrips, and a few scale insects, which have some kind of semi-symbiotic relationship with the plant. I should, however, hesitate to believe that it is possible to contrive any environmental condition whatever in which cotton plants would not be attacked by the cotton worm (*Alabama argillacea*), pink bollworm, leaf blister mite, or numerous other pests. It is certainly the case with some insects that *the healthier the plant is, the more it is relished by the pest.* Moreover, I do not believe that the silkworm feeds on unhealthy mulberry leaves, or that the locust confines its attention to plants with badly nourished protoplasm. Finally, such cases as that of the prickly pear, which was spreading in Queensland at the rate of hundreds of thousands of acres per year some years ago, and is now being destroyed at approximately the same rate by an introduced South American caterpillar, cannot by any figment of imagination be stretched on the Procrustean bed of Sir Albert's theory.

Yours faithfully,

S. C. HARLAND.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. The following reports have recently been received:
Review of Agr. Operations in India, 1931-33.
Imperial Council of Agricultural Research: Ann. Rpt. for 1934-35.
Indian Merchants' Chamber: Ann. Rpt. for 1935.
Punjab: Summary of Experimental and Research Work, 1930-35.

2. Review of Agricultural Operations in India, 1931-33. (Pubd. Delhi, 1936.) This report, issued recently, contains statistics of cotton acreage and production for the seasons 1931-33. The work of the Indian Central Cotton Committee in connection with the improvement of cotton growing and marketing and the various research schemes financed by the Committee are discussed. The Cotton Transport Act and the Cotton Ginning and Pressing Factories Act continued to function satisfactorily throughout the period under review.

3. Report of the Imperial Council of Agricultural Research, 1935-36. (Pubd. by Manager of Pubns., Delhi, 1936. Price: Annas 14, or 1s. 6d.) An account of the work of the year in connection with animal husbandry, agricultural research, soil science, sugar industry, costs of production of crops, and locust control.

4. Indian Cotton Industry: Protection. (*M/c. Cham. of Comm. Monthly Rec.*, **47**, 1936, p. 285. From *Summ. of Curr. Lit.*, xvi., **19**, 1936, p. 562.) A summary of the findings and conclusions of the Indian Tariff Board is given, including chapters reviewing the history of the Indian tariff in regard to cotton textiles since the first tariff board was appointed in 1926-27, and the progress achieved by Indian mills in recent years. Other chapters deal with the import and export trade of India in cotton and rayon textiles, the consumption of raw cotton, trading results of Indian mills, prices, effects of duties, and the handloom industry.

5. Indian Central Cotton Committee. The 33rd meeting held in Bombay on August 17 and 18 was formally inaugurated by His Excellency the Governor of Bombay. The following important matters were discussed: The valuable work done by the Lancashire Indian Cotton Committee to increase the use of Indian cotton in the United Kingdom; the question of wider markets for Indian cottons; legislation for the control of malpractices; regulation of cotton markets; measures for the control of pink bollworm. Satisfaction was expressed at the progress made by the twenty-nine agricultural research and thirteen seed distribution schemes financed by the Committee. A number of new research schemes were approved and several existing ones were extended for further periods. Appreciation was also recorded of the important work carried out at the Technological Laboratory, Bombay, and at the Institute of Plant Industry, Indore.

6. Indian Central Cotton Committee. We have received from the Publicity Officer the following notice:

Two New Cottons: Successful Bikaner Experiments. Research work financed by the Indian Central Cotton Committee, and commenced in 1931 to obtain by selection and hybridization improved types of cotton for the tract of country watered by the New Gang Canal in Bikaner, has shown Mollisoni and Cawnpore

520 cottons definitely to be the best varieties for the new colony. Seed is being multiplied up and will be sold to cultivators.

7. SPINNING TEST REPORTS ON INDIAN COTTONS, 1935-36. By N. Ahmad. (*Tech. Circs. Nos.* 226-230, 232-239, 241-257, 1935-36. Ind. Cent. Cott. Comm.) The circulars contain the grader's report and spinning test results for Navsari, Surat, Bailhongal, Tirupur Cambodia, Broach, Farm Westerns, Westerns, Hubli Kumpta, Hubli Upland, Jagadia, Kadi, Dholleras, Berar, African Busoga, Jinja, Khandesh, Kampala, Miraj, Karunganni, Northern Cambodia, Upland, Kadi-Viramgam, Bijapur, and Kalagin cottons for the 1935-36 season.

8. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS, 1936. By N. Ahmad. (*Tech. Bull. No.* 33, Ser. A, 1936. Ind. Cent. Cott. Comm.) The reports contain the results of tests on standard cottons of the thirteen seasons, 1923-36. As in former years, the agricultural details, grader's report, fibre properties, spinning tests, and remarks are given for each of the twenty varieties tested. Four cottons show an improvement over last year, five gave practically the same result, while eleven cottons show a falling off. The cottons showing improvement are Hagari 1, V.434 (Akola), Sind Sudhar and Umri Bani. The improvement in Sind Sudhar places it first among the standard Indian cottons as regards spinning performance.

9. TECHNOLOGICAL REPORTS ON INDIAN COTTONS, 1935-36. By N. Ahmad. (*Tech. Circs. Nos.* 225, 231, 240, 1935-36. Ind. Cent. Cott. Comm.) The particulars given include agricultural details, grader's report, fibre particulars, spinning tests, remarks, and conclusions.

Cambodia Co. 2.—Slightly neppy, but a distinct improvement noticeable in the 1935-36 season. Suitable for 30's warp.

Sind Sudhar.—Area under cultivation 20,440 acres. Slightly neppy. Suitable for 45's warp.

Surat 1027 *A.L.F.*—Slightly neppy. Suitable for 34's warp.

10. THE INTRODUCTION OF IMPROVED STRAINS OF CROP PLANTS IN CENTRAL INDIA AND RAJPUTANA. By J. B. Hutchinson and V. G. Panse. (*Agr. and Livestock in India*, vi., **4**, 1936, p. 397.) The results are summarized of 195 replicated trials with 106 strains of wheat, barley, linseed, *sarson* and *toria*, cotton, gram, groundnut, and *tur* in the seasons 1932-35 at forty-two centres in Central India and Rajputana. The following strains of cotton are recommended for distribution: Malvi 9 for Malwa, and Cwn. 520 for Bikaner Gang Canal Colony.

11. PUNJAB: *A Summary of Experimental and Research Work conducted by the Research Sections and at the Agricultural Stations,* 1930-31 *to* 1934-35. (Lahore, 1936. Price Rs. 2, or 3s.) The results of selection work carried out on American cottons at Lyallpur Cotton Research Station have shown three new strains, 36F, 38F, and 43F to be definitely superior to 4F. They are early maturing, have longer lint, but average ginning outturn is about 0·7 per cent. less. The first two cottons are susceptible to jassid, but 43F is jassid resistant and is being adopted by the Department of Agriculture. Progress has been made in the development of new strains of *desi* cottons, and Mollisoni 39 has been approved by the Department.

12. HOW SIND COTTON IS BEING IMPROVED. (*Text. Rec.*, liv., **642**, 1936, p. 20.) A brief description of the Sakrand Research Station and of the work on cotton that is being carried out there.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

13. The following reports have recently been received:
CYPRUS: Ann. Rpt. of Dpt. of Agr., 1935.
GAMBIA: Ann. Rpt. of Dpt. of Agr., 1935-36.
NIGERIA: 11th Ann. Bull. of Dpt. of Agr., 1932.
NYASALAND: Ann. Rpt. of Dpt. of Agr., 1935.
SUDAN: Rpt. of Agr. Res. Service, 1935.
,, Rpt. on Admin. Finan. and Condns. in the Sudan in 1935.
,, Ann. Rpt. of Dpt. of Econ. and Trade, 1935.
TANGANYIKA: Ann. Rpt. of Dpt. of Agr., 1935.
UGANDA: Ann. Rpt. of Dpt. of Agr., 1935.
WEST INDIES: *Barbados*, Agr. Jour. of Dpt. of Sci. and Agr., 1936, vol. ii.
,, *Montserrat*, Rpt. of Agr. Dpt., 1935.
,, *St. Kitts-Nevis*, Rpt. of Agr. Dpt., 1935.
,, *St. Lucia*, Res. Abstr. Rpt. of Dpt. of Agr., 1935.
,, *Trinidad and Tobago*, Admin. Rpt. of Dpt. of Agr., 1935.

14. EMPIRE COTTON GROWING: DEVELOPMENT AND PROGRESS. By Sir William Himbury. (*Cotton* M/c, 17/10/36, p. 21.) An interesting review of the progress of Empire cotton growing in 1935. A table is included giving areas, population, suitability of soils, production, and quality for the principal cotton-growing countries of the Empire, followed by a summary of the progress made, and a brief note on the prospects for 1936. It is gratifying to report that production of Empire cotton surpassed all previous records with a total output of some 700,000 bales. A proof of the all-round excellence of Empire cottons of American origin is that the entire production found a market, and in no instance was a carry-over necessary.

15. THE BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION: THE WORK OF THE SHIRLEY INSTITUTE, DIDSBURY, MANCHESTER. By Dr. R. H. Pickard, F.R.S. (*Cotton* M/c, 17/10/36, p. 25.) An interesting brief account of the work of the year in connection with the testing of samples of new cottons received from the Empire Cotton Growing Corporation and other sources. The work of the Institute on " chemical tendering " is also discussed.

16. ASIA. CYPRUS: *Cotton Cultivation*, 1935. (*Ann. Rpt. of Dpt. of Agr.*, 1935.) The year was a successful one for cotton, the yield more than doubling that of 1934. Work on cotton included time of sowing, fertilizer, varietal, spacing, and irrigation experiments. Mesowhite again gave the highest yield, but the Egyptian varieties, Giza II., III., VII., Nahda, Sakha II. and IV. were superior in ginning outturn.

17. IRRIGATION IN CYPRUS. By A. Pitcairn. (*Cyprus Agr. J.*, xxxi., **2**, 1936, p. 41.) A useful brief outline of the present position in regard to irrigation in Cyprus. No rapid strides have been made in recent years, but there is a tendency on the part of cultivators to introduce methods which research in irrigation have proved to be more advantageous than the old-established customs. Considerable progress has been made in exploiting water supplies on private properties, and necessary steps are being taken to instruct cultivators in proper methods of raising, storage, conveyance, application and duty of water. The area of cotton under irrigation in 1935 was estimated at 3,579 acres compared with 10,739 acres unirrigated.

18. AFRICA. GAMBIA: *Cotton Cultivation*, 1935-36. (*Ann. Rpt. of Dpt. of Agr.* 1935-36.) Varieties of cotton were introduced from India in 1931. Of these Cambodia has been grown in small quantities, and after five generations it is superior to the local Gambian variety, and is being multiplied up for distribution. The cotton crop generally was satisfactory.

19. KENYA COLONY: *Cotton Cultivation*, 1935-36. (*Ann. Rpt. of Dpt. of Agr.*, 1935, recently received.) The season was a successful one for cotton, production amounting to 15,636 bales as compared with 8,773 bales in 1934-35. Injury from pests was not serious. Selection work to obtain a variety suited to local conditions was commenced in the Coast Province: successful introductions were N.17 and its derivatives from Uganda for Nyanza Province, and U/4/4/2 for the coast. In the Central Province trials of U/4/4/22 and Nyanza strains carried out over the lower zones indicated that U/4/4/22 was the higher yielder. During the year the increasingly serious problem of soil erosion engaged the attention of the Plant Industry Division of the Dept. of Agriculture, and strenuous efforts were made to bring home the perils of soil erosion to all sections of the community, and to describe the methods by which it might be controlled.

20. NYASALAND: *Cotton Cultivation*, 1934-35. (*Ann. Rpt. of Dpt. of Agr.*, 1935, recently received.) A successful native cotton crop was harvested, production being double that of the previous season. This result was due to propaganda in favour of the crop, the establishment of new seed depôts and markets, and increased care in cultivation. European production of seed cotton amounted to 303 tons, as compared with 368 tons in 1934. The average price for No. 1 grade was 1·102d.; for No. 2, 0·539d.; and for No. 3, 0·370d. It is estimated that the sum of £89,555 was paid to Crown-land growers, and of that amount £80,066 was paid for No. 1 grade.

At the Corporation's Experiment Station at Domira Bay progress was made in the production of acclimatized strains of U.4 parentage, the most successful strain being once again C-28 from Barberton. A half-acre increase plot of a local reselection within this strain yielded at the rate of 220 lb. lint per acre, in spite of the drought experienced until mid-March. Other work carried out at the Station included rotation experiments, studies of the various cotton pests, and the search for a strain of cotton suited to the conditions of the Lilongwe plateau.

21. SOUTHERN RHODESIA: *Some Notes on Cotton Growing*. By J. E. Peat. (*Rhod. Agr. J.*, xxxiii., 7, 1936, p. 469.) These notes are for the benefit of prospective cotton growers in Southern Rhodesia, and deal with the soil, seed, time of planting, seed rate, depth of planting, spacing, cultivation, picking, and insect pests.

22. SUDAN. *Cotton Industry*, 1934-35. (*Rpt. on Admin. Finance and Condns. of Sudan*, 1935, recently received.) The cotton crop of the Gezira produced a yield of 4·461 kantars per feddan, which was well above the average. Injury from blackarm was not serious except in isolated areas. Leaf-curl also appeared, but measures taken to combat this disease proved of considerable value. The new "X.1530" strain of cotton was planted on 12,000 feddans in the Gezira, and produced an average yield of over 5 kantars. The area sown with cotton in the Gash was rather smaller than the previous year, but produced 69,250 kantars. Adverse climatic conditions affected the yield in the Tokar Delta, but a fair crop was harvested. American irrigated cotton suffered from bollworm, with a consequent reduced yield; the control of bollworm is an urgent problem in these areas. Remarkable progress was made in the Southern Provinces, a record yield of 144,137 kantars being harvested, compared with 86,800 kantars in the previous year.

The number of ginneries in operation during the year was twenty-four; two new ones are under construction in Kordofan.

23. *Cotton Industry*, 1935-36. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1934-35, issued 1936.) The Gezira crop made a promising start, but a prolonged cold

spell delayed boll opening and checked growth somewhat; it is hoped, however, that the yield may be about the average. The flooded area at Tokar during the current season is unusually small, but at Kassala is above normal. The whole of the former area and about one-third of the latter has been sown with X.1530 seed. The Gash crop is very promising indeed. The acreage sown in the Southern rain-grown areas has again been increased, but rather light and badly spaced rains have lowered the average yield.

24. REPORT OF THE AGRICULTURAL RESEARCH SERVICE, SUDAN, 1935. (*Ann. Rpt. of Dpt. of Agr. and Forests, Sudan,* 1935, Pt. II.) Since the publication of the last annual report on research work in the Gezira important changes in the organization of the agricultural research work have taken place. The Gezira Agricultural Research Service and the Entomological and Chemical staffs of the late Wellcome Tropical Research Laboratories have been amalgamated, the renamed "Agricultural Research Service" becoming a special Sub-Department of the Department of Agriculture and Forests.

In addition to the introductory note of the Director the report contains accounts of the experimental work carried out in the 1934-35 season by the Agricultural, Botany and Plant Pathology, Chemical, Entomological, Plant Breeding, Plant Observation, Plant Introduction, Plant Physiology, and Soil Research Sections.

From the note of the Director we learn that a very satisfactory average yield of 4·46 kantars of seed cotton per feddan was obtained for the whole irrigated area; the X.1530 strain gave 5·5 kantars. Little damage was caused by black-arm, but wet conditions during late June and early July favoured the persistence of ratoon cotton from the previous season, with the attendant risk of carry-over of leaf-curl disease. The fact that so little injury was caused by the disease indicated how well the previous crop was eradicated by hand pullers. Further information was accumulated about American bollworm, and measures of control were studied. The satisfactory yields of the crops on the "continuous cotton" plots go to show that there is little evidence of real deterioration in the Gezira soil. Good results were obtained from some fertilizers, especially with sulphate of ammonia buried rather than broadcast. A great deal was learnt about the development of the root system of the cotton plant and its relation to a wide range of fungi associated with it. Some fungi appeared to have the functions of mycorrhiza, others were parasitic, and the virulence of attack depended largely on the condition of alkalinity and aeration existing in the surrounding soil. Experiments on drainage upheld the view that drainage on an agricultural scale was practically impossible and might not eliminate the remarkable annual fluctuations in yield occurring at the present time. X.1530 cotton proved very satisfactory, and over 25,000 feddans were sown in the Gezira, the Gash Delta, and Tokar. The American selection "513" yielded well, and appeared to resist pink bollworm, which caused much damage on the northern pumping schemes. The search for host plants of this pest was continued.

25. WATER DUTY TRIALS IN THE SUDAN GEZIRA. By H. Greene. (*Trans. 3rd Internat. Congr. of Soil Sci.,* vol. iii., 1936.) As a general summary of this and similar experiments, it may be said that during the period of vigorous vegetative growth and increasing severity of climate, light or infrequent waterings are injurious, but heavy or frequent waterings, though conferring benefit on the crop, do not produce the large increase of yield that might be expected. It appears that the rather low permeability of Gezira soil sets, at this stage, a limit to the utilization of irrigation water, of which only a part sinks at all deeply into the soil, while the rest remains on or near the surface and is more or less wasted. On the other hand, if water is abundant and cheap, there is practically no risk of reducing the yield by heavy irrigation.

When the crop ripens, the interval between irrigations is usually lengthened to facilitate picking. Experiments have been carried out to ascertain what loss of crop ensues if irrigation is discontinued earlier than usual. The results are much as would be expected; in the case of a crop which has made poor growth, watering may stop a month or so earlier without much loss; on the other hand, late watering of a sturdy crop may carry it through the second period of vegetative growth and produce a reasonable return.

26. TANGANYIKA TERRITORY: *Cotton Cultivation*, 1934-35. (*Ann. Rpt. of Dpt. of Agr.*, 1935.) Native development was again outstanding in the Lake Province, and new records of exports are recorded for cotton and coffee. Estate production was confined to the Kilosa and Morogoro districts. Owing to planting cotton on the same lands year after year for some ten to fifteen years, yields have fallen to an unprofitable level. Many farmers consider the remedy lies in a change of seed, but better farming methods are required with rotation of crops and green manuring as the basis. New cotton-growing land was broken below the Rift Wall in the Mbulu district, but unless good farming is practised this area will suffer the same soil impoverishment as in the Eastern Province. Cotton growing under irrigation and rotation with maize and pulse crops gave yields of over a bale of lint per acre in the Northern Province. The total exports for the year amounted to 55,888 bales, against the previous record output of 31,612 bales in 1934. Given favourable conditions, it is anticipated that over 70,000 bales will be exported in 1936. Cotton pests were more in evidence than in previous years, much injury being caused by pink bollworm, stainers, *Helopeltis*, cotton weevil (*Apion xanthostylum*), aphis and jassid.

Valuable assistance was rendered by the two ginnery inspectors generously provided by the British Cotton Growing Association, and the substantial financial assistance given by the Empire Cotton Growing Corporation towards the maintenance of experiment stations and multiplication areas is gratefully acknowledged.

Selection work was continued with U.4 strains from Barberton, and gave very promising results.

In connection with the problem of soil erosion, communal efforts on anti-erosion work and reafforestation were successfully carried through with the willing co-operation of large numbers of natives.

27. UGANDA: *Cotton Cultivation*, 1935-36. (*Ann. Rpt. of Dpt. of Agr.*, 1935, Pt. I.) The total area planted to cotton was 1,366,974 acres. In most areas a considerable replanting of the main crop was necessary owing to the poor stand consequent on unsatisfactory weather conditions at planting time. Pink bollworm attack was not severe, but swarms of red locusts caused injury to native crops. Development of cotton wilt disease became serious, and it was proposed that the mycologist should make a study of the disease. The serious problem of soil deterioration, especially in the Teso district, came up for consideration by the authorities, and various remedial measures were suggested—*e.g.*, terracing, controlled grass fires, contour planting, mulching of perennial crops, green manuring, rotations, etc. The question of ploughing was also considered, with a view to obtaining a better standard of ploughing by the 13,000 ploughs now in use in Teso district.

28. *Cotton Prospects*, 1936-37. The latest report from the Dept. of Agriculture is to the effect that the estimated total acreage of 1,412,224 acres is some

46,695 acres in excess of the revised total of the previous year. Pests and diseases are less in evidence than usual, and the condition of the crop is above the average.

29. AUSTRALASIA. QUEENSLAND: *Cotton Industry*, 1935-36. (*Int. Cott. Bull.*, xiv., **56,** 1936, p. 402.) The major cotton-growing areas lie in the Callide and Dawson valleys, and these are experiencing the best season for some years. Labour is plentiful and everything seems favourable for a successful harvest for the cotton grower. The rate for ordinary cotton-picking has been settled on the same basis as that operating last year—10s. 6d. per 100 lb.

30. *Staple Length of Queensland Cotton.* (*Int. Cott. Bull.*, xiv., **56,** 1936, p. 403.) The average staple length was substantially reduced during the 1935 season as a result of the replacing of the longer stapled types with the more useful medium stapled cottons. The percentage of the various staple lengths is as follows:

$1\frac{1}{8}$ in. good	1·2400
$1\frac{1}{8}$ in.	8·2741
$1\frac{1}{16}$ in.	41·1643
1 in.	33·0210
$\frac{15}{16}$ in.	15·6458
$\frac{7}{8}$ in.	0·6544

31. WEST INDIES. THE COTTON INDUSTRY, 1935-36. (*Trop. Agr.*, xiii., **10,** 1936, p. 274.) In Montserrat dry weather conditions experienced in the early part of the year reacted unfavourably on crop production. Heavy rainfall in July and August resulted in much boll disease and serious injury from pink bollworm. The crop is estimated at about 700,000 lb. lint. The cultivation of cotton has been started afresh on a small scale in St. Lucia with seed obtained from Montserrat. As the outcome of a request by the West Indian Sea Island Cotton Association for the establishment of an entomological service, Mr. F. A. Squire, until recently Entomologist in British Guiana, has been appointed Entomologist for cotton pest investigation in the Windward and Leeward Islands. The appointment has been effected by means of financial assistance in the form of a free grant from Colonial Development funds.

32. *Sea Island Cotton.* (*W. Ind. Comm. Circ.*, li., **990,** 1936, p. 379.) From the review of the 1935-36 season by Messrs. Molyneux, Taylor and Co., Liverpool, we learn that satisfactory business was done at improved prices. The cotton is meeting a wider market, and a factor contributing to this has been the advertising campaign that has taken place for Sea Island goods. Another important factor is that manufacturers have been prepared to market their goods at a reasonable price. The prospects for the present season are hopeful, and prices are keeping fairly steady at 18d. to 20d.

33. BARBADOS: *Cotton Industry*, 1935-36. (*Agr. J. of Dpt. of Sci. and Agr., Barbados*, v., **2,** 1936.) Selected seed was distributed to applicants, but only a limited acreage was planted. Injury to the crop was caused by cotton leafworm (*Alabama argillacea*) and pink bollworm, and the yield was considerably reduced. The Peasant Cotton Plot Competition was again held in conjunction with the Peasants Agricultural Exhibition, and the judging of the plots was very difficult, the instructions being carried out by practically all the entrants. The first prize was awarded to a plot in the parish of St. Philip. To secure the introduction of only healthy material into the island, the holds of twenty-four ships were fumigated with Zyklon B, and 17,449 bags of imported cotton seed were disinfected by means of the Simon's Heater.

34. MONTSERRAT: *Cotton Cultivation,* 1935. (*Ann. Rpt. of Dpt. of Agr.,* 1935.) The total production of 948,928 lb. of clean lint constituted a record for the island. There was keen competition for the seed cotton and lint, and high prices were obtained. The demand for lint exceeded the supply, and many contracts had to remain unfulfilled at the end of the season. Cotton-breeding work was continued. The Montserrat type of Sea Island cotton is now well recognized in the cotton trade, and it is hoped to obtain complete uniformity of staple and increase in the productivity of the strain. The commercial fields showed practically 100 per cent. purity, and the lint received favourable reports from brokers and spinners. Late cotton in November suffered severely from pink bollworm.

35. *Cotton Industry,* 1936. (*W. Ind. Comm. Circ.,* li., **995,** 1936, p. 488.) Continuous wet weather, which has caused serious damage to be done by insect pests, has materially affected this year's Sea Island cotton crop in the Presidency, and the yield is expected to be considerably less than last year.

36. ST. LUCIA: *Sea Island Cotton.* (*W. Ind. Comm. Circ.,* li., **991,** 1936, p. 408). The Department of Agriculture have decided to encourage the growing of Sea Island cotton in the island. This will bring into cultivation parts of the colony which have not been under cultivation for a long time, and owing to many circumstances are not likely to be used for the present staple crops. The districts of Gors Islet, Vieux Fort, and part of Choiseul and Micoud, are the driest in the island and most suitable for cotton; in each sufficient acreage could be found suitable for settling a few hundred families.

37. ST. KITTS-NEVIS AND ANGUILLA: *Cotton Industry,* 1935-36. (*Ann. Rpt. of Dpt. of Agr., St. Kitts-Nevis,* 1935.) During 1935, late-planted cotton fields in St. Kitts were damaged by pink bollworm; little injury was caused to early cotton. Leafworm (*Alabama argillacea*) appeared in some fields, but was controlled by dusting with paris green. Stainers were more plentiful than in recent years. Injury from all three pests was serious in Nevis. Peasants have not been cleaning up their cotton plots satisfactorily, and in future the cotton control ordinances will be rigidly enforced. The purchasing of the peasants' cotton was again undertaken by the Government, an advance at the rate of 2d. per lb. for clean Sea Island cotton delivered at the cotton house being made to growers. The cotton was shipped to the British Cotton Growing Association, and was sold at a price which allowed a bonus of 1·85d. per lb. to the peasants after deducting all expenses. In Anguilla the crop was damaged by pink bollworm.

Work on cotton selection was continued with a view to effecting improvement in the agricultural properties of the St. Kitts strain; excellent reports have been received from brokers on the quality of the lint.

38. ST. VINCENT: *Cotton Industry,* 1935-36. (*Int. Cott. Bull.,* xiv., **56,** 1936, p. 404.) The total rainfall recorded from January to March was only 4·25 inches. This caused premature drying of late bolls, and the yield was disappointing. Excellent results were obtained for the early cotton, and the quality of the lint was very good. The crop suffered little injury from pests during the season.

39. *Cotton Industry,* 1935-37. A note on the cotton crop for the quarter ended September 30 last, received from the Superintendent of Agriculture, is to the effect that the Sea Island crop for 1935-36 is now estimated at 992 bales of 400 lb., the production of Marie Galante being 171 bales, or a total of 1,163 bales. The planting of Sea Island cotton for the 1936-37 season commenced on August 1, and continued until the end of September. Weather conditions were drier than usual, and some of the cotton fields suffered in consequence. Cotton caterpillar

(*Alabama argillacea*) appeared at the end of September. Some 5,000 acres were planted to Sea Island, or about 1,500 acres more than last year, and 700 acres were planted to Marie Galante cotton.

COTTON IN EGYPT.

40. The New Egyptian Cotton Contract in Liverpool. By J. A. Todd. (*Text. Rec.*, liv., **643**, 1936, p. 21.) A new futures contract to replace the existing Sakel contract on the Liverpool market was adopted unanimously in September last, and thus it is hoped to mark the end of a long-standing controversy. The new contract will at least go some way towards bringing the Liverpool and Alexandria contracts into line, but it will not get over the fundamental difficulty that Liverpool includes Sudan Sakel and Alexandria does not.

"With a possible crop not far short of two million kantars of Giza 7 this season, against Sakel something under half a million, the contract has, of course, substantially changed its character, being now a Giza 7 instead of a Sakel contract. But the contract should be much better protected than in recent years, and with the steady increase of Giza 7 it will not be liable to the same extent to domination by the Sudan Sakel crop. It should at least meet the major difficulty that buyers of Giza 7 had no contract providing an adequate hedge against their purchases, which in recent years were very largely of that variety and not of Sakel."

41. A Note of the Outlets for Egyptian Cotton by Countries and Varieties. By M. Ali Yehia. (*Int. Cott. Bull.*, xv., **57**, 1936, p. 98.) A discussion of the present consumption of Egyptian cotton in the chief countries of the world, compared with that of pre-war years, and of the factors that have led to fluctuations in the takings.

In the 1935-36 season 35 per cent. of the Egyptian crop was exported to England, 14 per cent. to France, 9 per cent. to Germany, 8 per cent. to Japan, 6 per cent. to Spain, and 5 per cent. to Italy.

42. Water-weight Changes in Export and Country Bales. By W. L. Balls. (*Tech. Bull. No.* 179, *Min. of Agr., Egypt*, 1936.) Mention is made of a recording apparatus used in determining water-weight changes in country and export bales of Egyptian cotton. The summarized history of an export bale is included and illustrated by graphs. It is shown that the past history of the bale affects its moisture content. The effects of average humidity, temperature, and penetration under stable conditions on another export bale are discussed and illustrated by graphs. The behaviour of a country bale in the open air is also investigated. The most striking fact resulting from the investigation is the ease with which atmospheric moisture can enter or leave the bale, as compared with the difficulty of liquid water. The next is the physical impossibility of ever measuring the weight of a bale exactly. The nearest approach to stability is probably attained when a large number of bales are stowed in a confined space such as the hold of a ship. The behaviour of country and export bales is not widely different. The fact, already well known, is confirmed that the construction of a storehouse, and especially its floor, has a marked effect on the weight of bales stored therein through the action of atmospheric humidity.

COTTON IN THE UNITED STATES.

43. American Cotton Industry, 1935-36. By H. Plauche. (*Cotton*, M/c, 17/10/36, p. 11.) The commercial cotton crop totalled 13,321,308 bales, compared with 9,470,362 bales in 1934-35, and 13,367,862 bales in 1933-34. In grade, the crop averaged about Middling and was not quite as high as last year. The staple was slightly better than last year, but the crop contained more than the usual percentage of untenderable cotton. Conditions in the cultivation and manufacturing industries were more satisfactory. Many useful tables of figures are included on production, carry-over, exports, internal mill consumption, etc.

44. COTTON AND THE AAA. By H. I. Richards. (*Washington, D.C., Brookings Inst.*, 1936. From *Exp. Sta. Rec.*, 75, **3**, 1936, p. 413.) The chapters deal with the legislative foundation of the cotton programme, the cotton situation in the spring of 1933, the cotton programme, cotton contract offers in 1933-35, the administrative organization, promotional campaigns, the contract sign-up, checking compliance, the landlord-tenant problem, the Bankhead Act and operations under it, Government cotton and cotton loans, financing the programme, the effects on foreign markets and on income, potential gains and losses, and the feasibility of continued control.

45. WORLD TEXTILES, WITH A REVIEW OF AMERICAN COTTON. (Pubd. by *Man. Guar. Coml.*, October 4, 1936.) Contains the following interesting papers: "American Cotton in 1935-36" (G. W. Fooshe). Discusses, among other matters, the invalidation of the Agricultural Adjustment Act by the Supreme Court, the repeal of the Bankhead Law through which compulsory control of production was effected, enactment of the Soil Conservation and Domestic Allotment Act, the working of the Commodity Credit Corporation and the Producers' Pool. "Outlook for the New American Crop" (C. T. Revere). Draws attention to the acute shortage of labour to harvest the crop in some of the cotton states.

46. PROGRESS IN IMPROVING THE QUALITY OF AMERICAN COTTON. By A. G. Black. (*Cotton*, M/c, 17/10/36, p. 17). Investigations carried out by the U.S. Dept. of Agriculture and the State Agricultural Experiment Stations are briefly discussed. These have for their object the improvement of the quality of American cotton by the development of more productive strains of better staple length and quality; early and more careful picking of the crop; drying seed cotton before ginning; the provision of suitable conditioning, cleaning, extracting, and ginning equipment that is properly operated; the use of improved bagging, packaging and storing facilities to prevent weather and other forms of damage to the cotton after it is ginned.

Experiments in crossing Hopi cotton—a low yielding but unusually fine and strong cotton grown by the Hopi Indians of Arizona—with Acala cotton have met with much success.

47. UNITED STATES: "COMMUNITY" COTTON GROWING. (*Text. Rec.*, liv., **641**, 1936, p. 65.) The Department of Agriculture finds that buyers are willing to pay more for cotton coming from a community where all growers cultivate only one variety, uniform in staple and seed produced. More than 300 one-variety communities have been developed where it is estimated more than 500,000 bales of improved cotton were produced last season. In Georgia, where such cotton commanded a premium of $3 per bale for 75,000 bales, the average increase in yield amounted to approximately 50 lb. lint per acre. A plan has been devised this year to include all of the cotton in the Blackland area of Texas in one huge unit—a total of more than 5,000,000 acres.

48. RESULTS OF THE REGULATION OF COTTON GINS AS PUBLIC UTILITIES IN OKLAHOMA. By R. A. Ballinger. (*Bull. No.* 230, *Agr. Exp. Sta.*, *Oklahoma*, 1936.) Oklahoma is the only state in the United States that regulates cotton gins as public utilities, which they have been since 1915. Details of rates for ginning, and comparisons with neighbouring states, are given for a number of years, also the differences in rates for picked and snapped cotton, etc. It is concluded that state regulation has increased the cost of ginning to the farmer, but as the ginners compete for the crop, he has obtained rather better prices for his cotton.

49. FINANCING AMERICAN COTTON PRODUCTION AND MARKETING IN THE UNITED STATES. Compiled by M. C. Benton. (*U.S. Dpt. Agr., Bur. Agr. Econ., Bibliog.* 61, 1935. From *Exp. Sta. Rec.*, 75, **1**, 1936, p. 124.) This bibliography covers the period 1897-1935, and includes 229 annotated references to periodicals and books relating to all phases of financing of American cotton from production through marketing.

50. AMERICAN COTTON: FARM PRICE, GRADE AND STAPLE. By L. D. Howell and J. S. Burgess. (*U.S. Dpt. Agr. Tech. Bull. No.* 493, 1936. From *Summ. of Curr. Lit.*, xvi., **18**, 1936, p. 499.) Details of a study extending over the seasons 1928-29 to 1932-33 of prices obtained for cotton in local markets of the U.S. Cotton Belt.

51. AMERICAN COTTON LINTERS: STANDARDISATION. By G. S. Meloy. (*U.S. Dpt. Agr. Misc. Pubn. No.* 242, 1936. From *Summ. of Curr. Lit.*, xvi., **18**, 1936, p. 520.) "Linters" and terms relating to colour, character, "cuts" and so forth are defined, and details are given of official standards. Seven grades are established and representative type samples are now prepared by the U.S. Dpt. of Agriculture. Uniform sub-grade terms are proposed.

52. GRADE AND STAPLE LENGTH OF COTTON PRODUCED IN GEORGIA, 1928-35. By N. M. Penny. (*Ga. Sta. Circ.* 107, 1936. From *Exp. Sta. Rec.*, 75, **3**, 1936, p. 412.) Tables are included showing the percentage distribution by grades and by staple length.

53. FIELD CROPS EXPERIMENTS AT THE SOUTH MISSISSIPPI SUBSTATION, 1932-35. By J. C. Robert and S. R. Greer. (*Miss. Sta. Bull.* 310, 1935. From *Exp. Sta. Rec.*, 75, **3**, 1936, p. 331.) Experiments with cotton included varietal trials, a comparison of commercial fertilizer and stable manure for cotton, comparative production trials of hemp, flax, ramie and cotton for fibre.

54. NEW MEXICO: *Agronomic Experiments*, 1935. (*New Mexico Sta. Rpt.*, 1935. From *Exp. Sta. Rec.*, 75, **1**, 1936, p. 36.) Research with cotton included varietal tests, breeding, cultural, fertilizer and irrigation experiments, and an investigation in connection with the grades and staple of New Mexico cotton.

55. NORTH CAROLINA: *Cotton Marketing Practices.* By G. R. Smith. (*N. Car. Sta. Tech. Bull.* 51, 1935. From *Exp. Sta. Rec.*, 75, **1**, 1936, p. 124.) The factors having an important influence on local marketing practices were found to be proximity of buyers to mills and export markets, contacts of local buyers with mills and cotton merchants, importance of cotton as a crop in the community, types of farming and sizes of farms, grade and staple of cotton grown and the variations in grade and staple lengths, the volume of local buyer purchases, inability on the part of both buyer and farmer to classify cotton accurately, established trading practices, credit facilities of farmers and local buyers, and the economic dependence and independence of producers.

56. TEXAS: *Agronomic Research.* (*Texas Sta. Rpt.*, 1934. From *Exp. Sta. Rec.*, 75, **1**, 1936, p. 37.) Work on cotton included varietal trials, development of varieties adapted to mechanical harvesting; anatomy and micro-chemistry of the cottonseed; effects of fertilizers on the length of cotton fibre; effects of weathering in the field upon grade, colour, and strength of raw cotton.

COTTON IN FOREIGN COUNTRIES.

57. THE COTTON INDUSTRY IN ARGENTINA. (*Text. Rec.*, liv., **641**, 1936, p. 19.) A survey, based on official information, of the spinning, weaving and knitting industries for the year 1935.

58. ARGENTINA: *Cotton Industry*, 1935-36. (*Int. Cott. Bull.*, xiv., **56**, 1936, p. 397.) Insect damage and unfavourable weather conditions have substantially reduced the cotton crop in the Chaco, and it is expected to be about 25 per cent. below that of the 1934-35 season. The greatest injury to the crop has been caused by the cotton leafworm and the pink bollworm, but rarely has the damage from the latter been so extensive as this season. Colonization in the Chaco is continuous, small towns are growing, and gins are being built; one American company has erected five new gins in the district this year. The Governor of the Chaco, after a recent visit to the United States, plans to inaugurate widespread improvements in production and marketing methods in the territory based on his observations in the United States.

59. LA CULTURE COTONNIÈRE AU CONGO BELGE. (*Bull. Trimestriel du Comité Cotonnier Congolais*, No. 1, 1936, p. 4.) The production of seed cotton in the Belgian Congo has risen from 1,770 tons in 1921 to 77,485 tons in 1935. Legislation has been passed by which the cotton-growing companies supply free seed to the natives, purchase the whole crop at a price fixed by Government, provide machinery to gin the whole crop by a given time, and organize markets under Government control for the purchase of native-grown cotton. In exchange, Government aids the cotton-growing companies by delimiting a cotton area within which cultivation is encouraged and developed, the companies giving technical assistance in this respect. This general organization has worked very well.

As the whole success rests upon the work of the natives, the buying price is fixed as high as is reasonably safe and allowing profit also to the purchasing companies. Improvement of transport is a great factor in success, and over 6 million francs (£42,500) are to be spent this year. Cotton has established itself as an important part of the general agriculture of the country, and has brought increased wealth and greater stability of residence to the people.

60. A CONTRIBUTION TO THE HISTORY OF THE INTRODUCTION OF COTTON GROWING INTO CHINA. By A. G. Grumm-Grzimailo. (In Russian.) (*Arkhiv. Istorii Nauki i Tekhniki* [*Archives of the History of Science and Technology*] *Trudy Instituta Istorii Nauki i Tekhniki*, 1934, Ser. I., **3**, pp. 173-82.) *Author's Summary.*—The cotton grown in China is not of local origin. The first mention made in the Chinese annals of the cotton plant and cotton goods refers to an epoch several centuries before our era. Wide recognition among the masses of Chinese farmers was gained by cotton cultivation only in the thirteenth and fourteenth centuries of our era.

The cultivation of the cotton plant has penetrated into China proper from the West—through Eastern Turkestan, where already in the fourth century its cultivation was widespread—as well as from the South, from Indo-China, which is one of the principal centres of origin of Asiatic cottons. From the West the cottons of the African group, *Gossypium herbaceum* L., were carried into China; from the South, those of the Indo-Chinese group, *G. Nanking* Meyen.

The above statement has been confirmed not only by the botanical diversity of the cotton grown in China, but also by linguistic data. The ancient Chinese name for the cotton plant, predominating in the northern provinces of the country, " bo-de " or " bai-de," is of Turkish origin; another name formerly used in the South, " chi-pei " or " ku-pei," is of Malayan origin. The modern names,

" mien " for the cotton plant, and " mien-hua " for lint cotton, came into existence not earlier than the fourteenth century of our era, during the epoch of the Ming dynasty.

Before gaining general recognition in China, the cotton plant had to contend for victory with silk and with the most ancient Chinese fibre plant, hemp, as well as with the prejudices of the population ignorant of and inexperienced in the cultivation of cotton, and the further handling of its products.

The chief reason for this slow introduction of the cotton plant into the rotation of crops grown by the farmers of the basin of the Yang-tse-kiang must be sought in the fact that the Chinese, having met in the South, in Annam, and in the adjacent southern regions (Tonking, Yunnan and Hainan), with cotton cultivated as a perennial plant, thought that the climatic conditions of the northern regions would be unfavourable to the crop. The transition from cotton grown as a perennial plant to its cultivation as an annual one could not be accomplished at once, but was protracted over centuries. Only when the Chinese began to cultivate cotton forms in which sympodial branching predominated—*i.e.*, forms producing a considerable number of fruits ripening in the first year—a turning-point in the history of Chinese cotton growing could be observed. Only then it became possible to extend the crop into comparatively northern regions of China where, owing to the ecological conditions, the cultivation of cotton as a perennial paint was not possible.

The first cotton-growing regions of China proper were the provinces Yunnan in the south-west, Kwangtung and Fukien in the south-east, and Shensi and Shansi in northern China. This is evidenced by all ancient Chinese records and memorials, and the historical data known to us are not at variance with this indication. Since ancient times the province Yunnan had been keeping up intercourse with Annam. The provinces Kwangtung and Fukien were those regions of China which since the second century of our era had been undergoing strong foreign influence, owing to their trade, and where since the third century numerous Arab settlements could be found. The provinces Shensi and Shansi, as well as the modern province Kansu, had been colonized by the Mongols with Iranians whose descendants were the modern Dungans. The latter were evidently the first who took up the cultivation of the cotton plant in this country.

Many years' practice of cotton growing in the above-mentioned provinces has revealed the error of the opinion formerly held by the populace, as well as by the governing classes, that the local climatic and soil conditions were not adapted for cotton cultivation. The investigations of the Chinese scientific workers of the Sung and Yuan periods, who persistently upheld that the cultivation of the cotton plant was possible nearly everywhere in the country, thus received practical confirmation. All this, along with the profitableness and importance of the crop, induced the Chinese Government, which formerly left the initiative to the population, to take the introduction of large-scale cotton growing into its own hands. This, however, was accomplished not earlier than in 1368, the beginning of the rule of the Ming dynasty, carried to the heights of power by the great wave of insurrection that swept away the empire of Yuan.

Since that time, cotton, as every new plant, has been forcibly introduced into the rotation of crops grown by the Chinese farmers, by Imperial edicts. Some of these edicts persuaded the population to give its attention to cotton growing, mentioning the various advantages of the crop, and pointing out the methods of its cultivation; other edicts, issued at the same time, compelled every farmer of a district, recognized by the Government as most suitable for cotton growing, to deliver every year to the court of the Bogdokhan a certain amount of the yield of the cotton plant, instead of a part of the poll-tax. The energetic propaganda showing the advantages of cotton cultivation and the strict measures taken by the Government during the first decades of the Ming dynasty led to a further spread of the crop from South and North to the central regions of the country, and at the beginning of the fifteenth century China could be regarded as having finally joined the ranks of the cotton-growing countries of the world.

61. CHINA: *Cotton Industry*, 1936. (*Int. Cott. Bull.*, xiv., **56**, 1936, p. 399.) A crop of 3,000,000 bales is expected, compared with 2,600,000 bales in 1935, and an average for the five preceding years of 2,471,000 bales.

62. MEXICO: *Cotton Acreage*, 1936. (*Int. Cott. Bull.*, xiv., **56**, 1936, p. 400.) The cotton acreage for 1936 is estimated at 300,000 hectares of 2·47 acres each, which represents an increase of 63,000 hectares over the previous year.

63. RUSSIAN TEXTILE INDUSTRY: ECONOMICS. By M. Wagner. (*Wirtschaftsdienst*, **21**, 1936, p. 953. From *Summ. of Curr. Lit.*, xvi., **15**, 1936, p. 442.) A table shows the production of cotton and cotton goods in the years 1934-36. Methods adopted to increase the cotton crop and its quality are briefly outlined. The production of finished goods does not correspond with the amount of modern equipment and the number of factories now in existence. This is accounted for by the poor quality of the cotton supplied, and the ignorance of workers who have to deal with complicated modern machines.

64. VENEZUELA: *Cotton Industry*. (*Int. Cott. Bull.*, xiv., **56**, 1936, p. 407.) Cotton has been added to the list of products entitled under the decree of January 27, 1936, to receive a bounty of 25 per cent. *ad valorem* on export shipments. The Ministry also announced on April 8 that the Bank of Venezuela would extend loans against stocks of cotton held for export under the same terms as are applicable to loans against export stocks of coffee. The loans will be made up to 80 per cent. of the current market value of the cotton, at 4 per cent. per annum, for periods not to exceed six months. The Government will pay warehousing and insurance charges on cotton stocks hypothecated in this manner, and will reimburse the bank for any losses it may suffer on account of falling prices. Up to this time, cotton had not been exported from Venezuela in commercial quantities.

SOILS AND MANURES.

65. ROTHAMSTED EXPERIMENTAL STATION. In the Report for 1935 it is stated that much steady progress has been made in all departments, and some of the old work has reached a definite stage where it can be regarded as sufficiently advanced for final publication, and a new direction can be given to the programme.

The work of the year in connection with crop production, grassland experiments, arable and vegetable crops, fertilizers, soils, plant pathology, entomology, insecticides, mycology, etc., is discussed. The library now contains some 26,000 volumes dealing with agriculture and cognate subjects. During the year under review 106 papers were published in various scientific journals, and summaries of 68 of these are included in the report. The report of the Woburn Experimental Farm for 1934-35 is also included.

66. TROPICAL SOILS IN RELATION TO TROPICAL CROPS. (Pubd. by Imp. Bur. of Soil Sci., Harpenden, England, *Tect. Commn. No.* 34, 1936. Price 2s. 6d.) This communication is arranged in crop sections, dealing with sugar cane, rice, cotton, citrus, bananas, coconuts, rubber, tobacco, coffee, cacao, and tea; each section comprises a brief summary of the crop's soil requirements followed by descriptions of the actual (not necessarily the optimal) soil conditions under which the crop is grown in the chief producing countries. A list of references to literature cited in the text is appended to each section.

67. DEVELOPMENT AND SIGNIFICANCE OF THE GREAT SOIL GROUPS OF THE UNITED STATES. By C. E. Kellogg. (*U.S. Dpt. Agr., Misc. Pubn.* 229, 1936. From *Exp. Sta. Rec.*, 75, **2**, 1936, p. 164.) The nature of soils and the environmental factors responsible for their genesis are briefly discussed, and illustrations of the great groups of soils are included and explained.

68. A BRIEF REVIEW OF THE DEVELOPMENT OF THE MECHANICAL ANALYSIS OF SOILS. By V. Novak. (*3rd Internl. Cong. Soil Sci., England*, 1935, *Trans.*, vol. ii. From *Exp. Sta. Rec.*, 75, **2**, 1936, p. 163.) An outline of the history of the mechanical analysis of soils from 1800 to the present time. Methods of which the origin and development are taken up include the decantation, the sinker, the volumetric, and the pipette methods, methods dependent upon the determination of the continuous sedimentation curve without separation of individual fractions, and the washing methods. The representation of the mechanical composition, both numerically and graphically, is also considered, as are the preparation of the samples and the applications of the mechanical analysis of soils. Names of the principal contributors to the technique of mechanical soil analysis, with the dates of publication of their work, are given, but specific journal references are not cited.

69. DIRECT MICROSCOPIC AND BACTERIOLOGICAL EXAMINATION OF THE SOIL. By G. Rossi *et al.* (*Soil. Sci.*, xli., **1**, 1936, p. 53. From *Exp. Sta. Rec.*, 75, **2**, 1936, p. 163.) The authors describe three methods for obtaining preparations of soil micro-organisms for microscopic study: the impression method, the crushing method, and the method of burying the slides in pairs in the soil to be investigated. The third method is now the only one in use.

70. THE PRINCIPLES OF THE CHEMICAL CHARACTERIZATION OF THE SOIL. By A. A. J. de Sigmund. (*3rd Internl. Cong. Soil Sci., England*, 1935, *Trans.*, vol. ii. From *Exp. Sta. Rec.*, 75, **2**, 1936, p. 163.) Discusses briefly various methods of soil analysis and the interpretation to be placed upon the results. The paper is accompanied by illustrative data.

71. ON THE NATURE OF REACTIONS RESPONSIBLE FOR SOIL ACIDITY. Pt. IV.: INTERPRETATION OF TITRATION CURVES. By J. Mukherjee *et al.* Pt. V.: TITRATION CURVES OF CLAY ACIDS. By R. Mitra. (*Ind. J. Agr. Sci.*, vi., **3**, 1936, pp. 517 and 555.)

72. THE MENACE OF SOIL EROSION. (*Crown Colonist*, September, 1936, p. 398.) Sir Daniel Hall dealt with this subject in the Heath Clark lectures of the London School of Tropical Hygiene. The chief causes of soil erosion in Africa are shifting cultivation and overstocking, and the remedial measures suggested are: (1) The introduction of a conservative system of farming in place of shifting cultivation; (2) compulsory reduction of live stock; (3) planting, terracing and other constructive methods to reduce run-off.

73. SOIL EROSION AND ITS CONTROL IN THE UNITED STATES. By W. C. Lowdermilk. (*3rd Internl. Cong. Soil Sci., England*, 1935, *Trans.*, vol. ii. From *Exp. Sta. Rec.*, 75, **2**, 1936, p. 170.) A brief outline of the problem of soil erosion, or man-induced erosion, and its control in the United States. The subject falls naturally into three parts: (1) A review of the condition of the American Continent when the English colonists cleared their first cornfields; (2) the present condition of the land after three centuries of agricultural exploitation; and (3) measures that are being taken to meet the menace and challenge of soil erosion to the people of the United States.

74. SCHEMES FOR SOIL EROSION CONTROL AND WATER CONSERVATION. (*Farmg. in S. Afr.*, xi., **124**, 1936, p. 299.) A brief summary of the various schemes under which Government assistance is afforded for the control of soil erosion and the building of small dams for water conservation in South Africa.

75. STUDIES ON THE USE OF THE TERRACING PLOUGH FOR SOIL CONSERVATION. By H. J. Harper. (*J. Amer. Soc. Agron.*, 28, **4**, 1936, p. 301. From *Exp. Sta. Rec.*, 75, **3**, 1936, p. 408.) Studies carried out at the Oklahoma Experiment Station to determine the limitations of the terracing plough in a soil conservation programme. It is an inexpensive tool and can easily be operated by the power available on the average farm. It was found that the effective height of terrace ridges could be increased by ploughing twice in the same furrow for three or four rounds. When a riding plough is used, a deep narrow furrow slice should be moved toward the terrace ridge. A mouldboard designed with the outer end flattened and bent slightly to the rear at a point about 22 inches from the edge of the land side will operate easier along crooked furrows in soil where sods are frequently encountered, and in soil which tends to stick near the end of a straight mouldboard.

The draught of a terracing plough is very similar to that of a general purpose plough when operating under similar conditions. A plough operating in subsurface soil requires about twice as much power as the same plough operating in surface soil. When terrace ridges are being constructed with a terracing plough, the land should be planted to small grain or some other crop which will cover the surface of the ground and reduce the erosion which may occur from breaks in the low ridges, unless the ridges can be ploughed two or three times during the fall or winter in order to increase the effective height. When row crops are grown, the rows should be planted on a contour and parallel with the terrace ridge. The terracing plough is more useful than a backfilling plough or an ordinary plough in gully control work where soil is removed from the upper edge of a bank in order to establish a more vigorous growth of vegetation in the bottom of the ditch.

76. A HOME-MADE TERRACING IMPLEMENT. By C. D. Hill. (*E. Afr. Agr. Jour.*, ii., **1**, 1936, p. 77.) Describes the conversion of a 3-furrow Hercules plough into a terracing implement.

77. SOIL EROSION: A SIMPLE HOME-MADE LEVEL FOR OBTAINING THE LINE OF CONTOUR BANKS. (*E. Afr. Agr. Jour.*, ii., **1**, 1936, p. 28.) A description, with diagram, of the instrument.

78. A PASTURE CONTOUR FURROWING MACHINE. By C. A. Logan. (*Agr. Eng.*, 17, **3**, 1936, p. 111. From *Exp. Sta. Rec.*, 75, **3**, 1936, p. 408.) A description of the machine.

79. HUMUS: ORIGIN, CHEMICAL COMPOSITION AND IMPORTANCE IN NATURE. By S. A. Waksman. (Baillière, Tindall and Cox, London, 1936. Price 30s. Reviewed in *Trop. Agr.*, xiii., **9**, 1936, p. 249.) From this review we extract the following: " This book has been written by a recognized American authority on soil organic matter and its natural transformation; it brings together in readable and attractive form much information, which is scattered throughout the literature of Soil Science, and is otherwise difficult to procure. . . . Among the topics considered are the following: the rôle of humus in plant nutrition; humidification of organic matter in composts, manures and soils; origin and chemical nature of humus; methods of determination of humus; humus in forest soils, heath soils, mineral soils, peat and coal; physical properties of humus; utilization of humus for agricultural and industrial purposes. Over thirteen hundred references are cited in the bibliography and considered in the text. . . .

No other book contains such a mine of information on the subject, and no agricultural or soils library is complete without a copy of the book on its shelves."

80. THE MOBILIZATION OF PLANT NUTRIENTS IN THE SOIL. By C. Barthel. (*3rd Internl. Cong. Soil Sci., England,* 1935, *Trans.,* vol. ii. From *Exp. Sta. Rec.,* 75, **2,** 1936, p. 171.) This brief and rather general discussion is concerned mainly with the part played by micro-organisms in making organic nitrogen and carbon available to the higher plants. The mobilization of such other elements as phosphorus, sulphur, and calcium is mentioned, but is not discussed.

81. DETERMINATION OF NITROGEN IN SOILS. By V. Subrahmanyan. (*Agr. and Livestock in India,* vi., **3,** 1936, p. 284.) A brief discussion of recent literature on the subject.

82. UTILIZATION OF CERTAIN FORMS OF INORGANIC NITROGEN DURING THE DECOMPOSITION OF PLANT MATERIALS IN THE SOIL. By J. G. Shrikhande. (*Ind. J. Agr. Sci.,* vi., **3,** 1936, p. 767.) Incorporation of straw with soil lessens the amount of ammoniacal and nitric nitrogen present in the soil. When straw and an almost equal dressing of ammonium sulphate and sodium nitrate are introduced into the soil, there is a definite preference by the micro-organisms concerned in the decomposition for ammoniacal nitrogen in preference to nitric nitrogen, in the dry cultivated soil; the reverse may be the case in the wet cultivated soil. Nitrate penetrates both dry and wet soils quicker than ammonia; ammonia penetrates the dry cultivated soil quicker than it does the wet soil; the rate of movement is rather slow.

CULTIVATION, IRRIGATION, GINNING, ETC.

83. A NEW METHOD OF ARRANGING VARIETY TRIALS INVOLVING A LARGE NUMBER OF VARIETIES. By F. Yates. (*J. Agr. Sci.,* **26,** 1936, p. 424. From *Pl. Bre. Absts.,* vii., **1,** 1936, p. 2.) The ordinary methods of randomized blocks and the Latin Square become impracticable when the number of varieties to be tested is large. A possible method is to divide the varieties into sets, keeping one as a control, each set being arranged with the controls in a number of randomized blocks. Comparisons between varieties in different sets are, however, of lower accuracy than comparisons in the same set. Alternatively a number of controls may be interspersed systematically among the varieties, and a fertility measure calculated for each plot. Comparisons may then be made by using this fertility measure as a concomitant observation. The amount of land that has to be given to the control in any such experiment tends, however, to lower its efficiency, and in an attempt to avoid the various defects of such methods and at the same time to avoid the use of excessively large blocks, a *pseudo-factorial* type of arrangement is suggested. The varieties are divided into sets for comparison in more than one way, the sets of each division being so arranged that they cut across those of all the other divisions. The paper discusses in detail the analysis and efficiency of the different types of arrangement that are possible.

84. THE VALUE OF GRASSLAND CULTIVATIONS IN COTTON ROTATIONS. By W. G. Wells. (*Queensland Agr. J.,* xlvi., **1,** 1936, p. 59.) In advocating that farmers should grow their cotton crops in rotation with grassland, the author states that where such a system is practised the crop is grown on soil which has a suitable carbon-nitrogen ratio for the production of good yields of cotton, and a physical condition that allows of a high degree of efficiency of penetration of even storm rains being obtained. In addition to these factors, the grassland rotation tends to suppress weed growth. The net result is the obtainment of an increased yield of lint per acre, an improvement of quality, and a marked reduction in cost of production, both through increased yield and lessened cultivation costs.

85. THE MECHANICAL COTTON PICKER. (*N.Y. Jour. of Comm.*, 5/9/36.) Further experiments with the mechanical cotton picker invented by Messrs. Rust Brothers indicate that although the machine is acknowledged as the closest approach to a successful device, it still has some serious mechanical drawbacks. The principal objection is that the spindles pick up cotton from bolls which have begun to open, but are not fully mature. The quality is definitely lowered, and the loss in value of the cotton so harvested may amount to as much as £3 per bale. The Rust picker is best adapted to large-scale farming and for use in level country such as Texas, rather than in the hilly land of Georgia.

86. COTTON GIN: HISTORY. By J. W. Roe. (*Mech. Eng.*, **58,** 1936, p. 386. From *Summ. Curr. Lit.*, xvi., **15,** 1936, p. 424.) An account is given of the invention of the cotton gin by Eli Whitney and the circumstances which led up to the invention, in refutation of a recent claim that the true inventor was Whitney's patron, Mrs. Nathaniel Greene.

87. POWER REQUIREMENTS IN COTTON GINNING PLANTS. By V. L. Stedronsky. (*Assoc. South. Agr. Workers Proc.* 35, 1934. From *Exp. Sta. Rec.*, 75, **3,** 1936, p. 408.) In a contribution from the U.S. Dpt. of Agr., Bureau of Agricultural Engineering, the power requirements for cotton ginning are summarized.

88. SUGGESTIONS TO MANAGERS OF GINNERIES. By N. Field and P. W. Briggs. (*E. Afr. Agr. Jour.*, ii., **2,** 1936, p. 171.) Suggestions to managers of ginneries in Tanganyika Territory on the working of steam power plants, internal combustion engines, seed cotton openers, ginning machines, baling presses and pumps.

89. PROGRESS IN GINNING TESTS AND GIN TESTING INSTRUMENTS. By C. A. Bennett. (*Int. Cott. Bull.*, xiv., **56,** 1936, p. 461.) A paper read before the Texas Cotton Ginners' Association. The author states that ginning troubles due to excess moisture in the seed cotton can be overcome with driers. In working upon gin-saw tooth shapes, analyses have shown significantly better action for straight than for modified roach teeth. On cotton longer than 1⅛ inches the straight teeth gave an average of 13 lb. more lint per bale on the loose rolls, and approximately 8 lb. more for tight seed rolls than the roach teeth. On cotton shorter than 1⅛ inches the straight teeth averaged approximately 11 lb. more on loose rolls and 9 lb. more on tight rolls than the roach teeth. Analyses on many cottons at three saw speeds showed that increased pitch of 3½ degrees gave normally dry 1⅛ inches and longer cottons 5 lb. more lint than standard pitch for both loose and tight seed rolls. With normally dry cottons shorter than 1⅛ inches the straight teeth averaged 5 lb. more lint for tight seed rolls than standard pitch. Other investigations are in process of bearing result.

90. EFFECTS OF GIN-SAW SPEED AND SEED-ROLL DENSITY ON QUALITY OF COTTON LINT AND OPERATION OF GIN STANDS. By C. A. Bennett and F. L. Gerdes. (*U.S. Dept. Agr. Tech. Bull. No.* 503, 1936. From *Exp. Sta. Rec.*, 75, **1,** 1936, p. 117.) Studies are reported, the purpose of which was to determine, among other matters, the relative influence of gin-saw speed and seed-roll density on the quality of ginned lint and on the ginning capacity, power requirement, and energy consumption during ginning. Brush and air-blast gins were used. The 98 specially selected American Upland seed cottons employed in the tests were taken from the crop years 1930-34 inclusive, and were grown in 11 States, from Virginia to Texas and Oklahoma. In moisture content they ranged from 6·8 to 20·2 per cent., in staple length from $\frac{13}{16}$ to $1\frac{9}{32}$ inches, and differed also in other characteristics. The results of tests on lint quality are presented for

46 cottons, and of tests relating to lint turn-out, lint value, ginning time, power required, and energy consumed for from 9 to 57 cottons.

The results showed that lowering the gin-saw speed 100 r.p.m. below the manufacturer's recommended speed improved the quality slightly, but raising the speed 100 r.p.m. did not change the quality appreciably. Changes in seed-roll density caused by changes in the rate of feeding seed cotton to the gin stand are much more important than changes in gin-saw speed in affecting the quality of the ginned lint and the mechanical operation of the gin stand. Loose-roll ginning gave the better quality cotton. The effects of variations in the method of ginning employed with a wide range of cottons were materially greater on the preparation component of grade than on any other quality element. No real effect of gin-saw speed on staple length was found. As the seed-roll density was changed, the staple-length differences between loose- and tight-roll samples showed slight tendencies for the loose-roll samples to be classed longer. Laboratory determination of the upper quartile length and of the variability of fibre length showed little relation of these elements to the gin-saw speed or the seed-roll density. Grade differences due to variations in gin-saw speed averaged less than one-fifth of a grade improvement for the low speed. The change due to increasing the speed was negligible. Grade differences due to change in seed-roll density amounted to nearly two-thirds of a grade in favour of the loose roll.

91. EFFECT OF ARTIFICIALLY DRYING SEED COTTON BEFORE GINNING ON CERTAIN QUALITY ELEMENTS OF THE LINT AND SEED AND ON THE OPERATION OF THE GIN STAND. By F. L. Gerdes and C. A. Bennett. (*Tech. Bull. No.* 508, *U.S. Dpt. of Agr., Washington, D.C.*, 1936.) Damage done to cotton in ginning is often the fault of the grower—the cotton is too moist, or has not been carefully picked. Pickers, for example, paid by weight picked, are sometimes inclined to include bolls that are too "green." A vertical drier for artificially drying damp or wet seed cotton has recently been developed. The present study is concerned with drying, and sixty-nine American Upland cottons were used in experiments conducted with a view of determining (1) the relationship and interrelationships between the moisture content of seed cotton, the resulting quality of ginned lint, the amount of moisture that may be removed by artificial drying without reduction of fibre quality, and the desirable mechanical operation of the gin stand when handling cottons of different moisture content; (2) the proper drying temperatures for cottons of different moisture content. The seed cottons used varied in moisture content from 6·8 to 26·4 per cent.; in staple length from $\frac{7}{8}$ to $1\frac{9}{32}$ inches, and they varied widely in other characteristics. Portions of the seed cottons, dried and undried, were ginned on both brush and air-blast types of gin at constant saw speeds and with loose and tight seed-roll densities, but as the results were similar for both types of gin, only those for the brush type gin are presented.

The amount of moisture removed from seed cottons by drying at a temperature of 150° F. averaged from 1 lb. per 100 lb. seed cotton for those with less than 12 per cent. moisture, to 3 lb. for those having 16 per cent. or more. The amount of moisture removed at higher temperatures was only slightly greater than that at 150°. The amount of moisture removed from lint per 100 lb. by drying at 150° F. ranged from an average of 1·5 lb. for seed cottons below 12 per cent. in moisture to 4 lb. for those having 16 per cent. or more, and increased slightly with higher drying temperatures. The unfavourable effects of ginning cottons with excess moisture were intensified as the staple length of the cotton was increased and as the seed-roll density was changed from loose to tight. Average grade improvements as a result of artificial drying were more pronounced for the longer than for the shorter cottons. Drying at a temperature of 150° F. showed grade benefits ranging, on the average, from about one grade for either length group having 16 per cent. or more moisture, to approximately one-third of a grade for longer cottons having 8 to 11·9 per cent. and the shorter cottons having 12 to 15·9 per cent. moisture. Staple length, on the average, was preserved when the seed cotton was dried at 150° F., but drying temperatures above 200° F. were associated with shortening of staple to an extent of $\frac{1}{32}$ to $\frac{1}{16}$ of an inch. At temperatures up to 200° F. average fibre strength was not weakened. The temperature of the hot air at the inlet of the drier should not greatly exceed 150° F., except for very wet cotton, and then should seldom, if ever, exceed 200° F. The critical temperature is reached sooner with short-staple or lower moisture-content than with long-staple or higher moisture-content cottons.

92. SEED COTTON: DRYING AND AIR RESISTANCE. By B. F. Balsson. (*Invest. U.S.S.R. teplotech. Inst.*, **12,** 1935, p. 33. From *Summ. of Curr. Lit.*, xvi., **15,** 1936, p. 424.) Seed cotton of different degrees of ripeness was dried in a vertical shaft by a current of electrically heated air of velocity (v) 0·2 to 1·0 metre per sec., the depth of the mass (h) varying from 10 to 20 cm., and the closeness of packing varying also. The air resistance (ΔS) was found to be given by $\Delta S = A.h.p.v.^n$ where A and n are constants and p is the ratio of the weight of the cotton to that when the packing is " loose." The degree of ripeness influences drying in that well-developed seeds give up their moisture slowly. If the seed is to be used for sowing it may be heated to 60° C. A temperature of 100° C. is without harm to the fibre.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

93. A NEW APPARATUS FOR SEPARATING INSECTS AND OTHER ARTHROPODS FROM THE SOIL. By W. R. S. Ladell. (*Ann. App. Biol.*, xxiii., **4,** 1936, p. 862.) From the summary we quote: " The principle of the method is flotation by a dense liquid (solution of magnesium sulphate of sp. gr. 1·11), aided by stirring of the soil and a stream of fine air bubbles passing from the bottom upwards through the mixture of soil and solution. This produces a froth which contains all the animals, and by raising the level of the liquid in the cylinder the froth is swept over into a tank filled with magnesium sulphate solution; here is deposited any soil that has been carried over. The clear solution is then passed on to a Buchner funnel where the insects and other animals are retained. A black filter paper is used in order to show up *Collembola* and other organisms."

94. A LIST OF COTTON INSECTS OF THE WORLD. By F. Li and T. Ma. (*Yearbook Bur. Ent., Hangchow,* **4,** 1934, p. 245. From *Rev. App. Ent.*, xxiv., Ser. A., **7,** 1936, p. 481.) A systematic list is given of 768 species of insects and mites that infest cotton, showing the countries in which they occur and the parts of the plant they attack.

95. BARBADOS: *Parasites introduced for the Control of Insect Pests.* By R. W. E. Tucker. (*Agr. J. Dpt. of Sci. and Agr., Barbados,* vol. v., **1,** 1936.) The introduction in 1929 of *Microbracon kirkpatricki* to control pink bollworm was unsuccessful since no parasitism of the bollworm larvæ occurred, and the biological project was therefore abandoned.

96. CYPRUS: *Injurious Insects.* By H. M. Morris. (*Cyprus Agr. J.*, xxxi., **3,** 1936, p. 83.) The major pests of cotton in Cyprus are pink bollworm and spiny bollworm (*Earias insulana*). Injury is also caused by *Laphygma exigua* and *Heliothis obsoleta* (American bollworm), but not to the same extent.

97. PERU: *Los Insectos del Algodonero en los Valles de los Departmentos de Lambayeque y la Libertad.* By C. Lamas. (*Bol. Direcc. Agric. Ganad., Peru,* v., **19,**

1935, p. 60. From *Rev. App. Ent.*, xxiv., Ser. A., **9**, 1936, p. 571.) In July, 1935, *Dysdercus ruficollis*, L., occurred in all the valleys on wild malvaceous plants and on cotton, 75 per cent. of the bolls being infested in some cases. In one locality cotton plants 2-3 weeks of age were killed by *Gasterocercodes gossypii*, Pierce, in fields where ratoon had been infested in the preceding year. Old plants must be uprooted completely after harvest. A wild malvaceous plant, *Malachra* sp., growing in fields of rice stubble, was one of the principal food plants of *G. gossypii*. Other cotton pests included *Anthonomus vestitus*, Boh., *Pinnaspis (Hemichionaspis) minor*, Mask., *Mescinia peruella*, Schaus, *Tetranychus* sp., and *Anomis luridula*, Gn. (*texana*, Riley). The last-named was parasitized by *Rhogas* sp. and *Eucelatoria australis*, Tns.

98. THE COTTON WORM IN EGYPT. (*Int. Cott. Bull.*, xiv., **57**, 1936, p. 441.) The presence of cotton worm has been notified from all over Egypt, the pest having made its appearance slightly earlier than usual. The Government is, however, ready in advance this year. The country has been thoroughly mapped out into small divisions under the supervision of inspectors and other officials, and there is little danger of surprise attacks. A careful watch is being kept, and when an attack is signalled large gangs of men, women, and children are sent to the infected area to go through the crops picking off all worm-infected leaves and burning them. Experiments are also being carried out to find a spraying mixture which will destroy all pests, while not harming the plant.

99. THE CANNIBALISTIC HABITS OF THE CORN EARWORM (*Heliothis obsoleta*). By G. W. Barber. (*U.S. Dpt. Agr., Tech. Bull.* 499, 1936. From *Exp. Sta. Rec.*, 75, **2**, 1936, p. 229.) In studies of the larvæ of the corn earworm conducted at Richmond, Virginia, in 1929, and at Savannah, Georgia from 1930-32 inclusive, its population in ears of corn was found to be limited by the cannibalistic habit. Notwithstanding the large number of eggs that may be deposited by the moths on corn silks, only a single larva survives in each ear. Individuals were reared to adults from all larval instars and from the egg with no other food than their fellow larvæ, one larva having consumed some twenty fellow larvæ of its own size in the several instars through which it passed to complete its growth. This habit protects the corn crop, for if all the larvæ that hatch should survive, that is if the larvæ were not cannibals, the entire crop might be devoured. The extent of the cannibalism depends upon the character of the husk, as this determines the points of entry of the larvæ and the feeding area within the ear. Advantage may be taken of this habit, therefore, by breeding a type of corn-ear that will promote cannibalistic feeding. This consists in developing a longer and tighter husk to limit feeding areas, and thus cause larvæ to encounter one another more readily.

100. EXPERIMENTS FOR THE CONTROL OF LARVÆ OF *Heliothis obsoleta* FABR. ON WESTERN LONG ISLAND DURING 1935. By L. A. Carruth. (*J. Econ. Ent.*, xxix., **1**, 1936, p. 205. From *Exp. Sta. Rec.*, 75, **2**, 1936, p. 229.) A report of two experiments, the first relating to a comparative field test of certain mechanical and insecticidal treatments against the pest, and the second to corn grown within a moth-tight enclosure.

101. LEAD ARSENATE AND WETTING AGENTS FOR CORN EARWORM CONTROL. By B. B. Fulton. (*J. Econ. Ent.*, 29, **2**, 1936, p. 466. From *Rev. App. Ent.*, xxiv., Ser. A., **9**, 1936, p. 545.) Wetting agents hitherto used to carry lead arsenate deeply into maize silks for the control of larvæ of *Heliothis armigera* Hb. (*obsoleta*, F.) have been unsatisfactory, as they fail to penetrate, injure the ear or impart an undesirable flavour. New wetting agents applied during the summer of 1935 at 0·25 per cent., combined with lead arsenate at 0·5 per cent., caused severe injury to many ears, but in a second series of experiments made in August, when nfestation was at its maximum, the concentration of both ingredients was reduced by half and little injury resulted, control of *H. armigera* being better than any previously obtained under similar conditions. With four applications at four-day intervals, the percentages of infestation were as follows: SS-3, 34 per cent.; sodium oleyl sulphate, 17 per cent.; lethane spreader, 59 per cent.; tergitol-7, 54 per cent.; sodium lauryl sulphate, 58 per cent.; lead arsenate alone (dust), 82 per cent.; control, 99 per cent. The percentage infestation includes all ears with living larvæ on the cobs or in the silk. The liquids were applied with a specially prepared nozzle delivering a fine straight jet directed on to the silks from above for one second.

102. FLEA HOPPER CONTROL IN U.S.A. (*Int. Cott. Bull.*, xiv., **56**, 1936, p. 420.) The Texas Agricultural Experiment Station Circular No. 77 describes various types of dusting machinery, " the most practical of which for the average cotton farm is the wheel traction cart duster, which is usually built with three to five nozzles, and is pulled by two mules. This machine will care for approximately 100-125 acres of infested cotton; it is less expensive than the power cart duster, which has a fan operated at high speed by a gasolene motor. While somewhat more expensive than the traction machine, the power duster permits dusting under more adverse atmospheric conditions than any of the ground machines, and will care for a larger acreage. For large-scale dusting, the airplane dusting service has been found both economical and effective."

103. THE COTTON LEAF ROLLER (*Sylepta derogata*, Fb.) IN THE PUNJAB. (*Summ. of Exp. and Res. Work of Res. Sections and Agr. Stats.*, 1930-31 *to* 1934-35, p. 175.) This pest has caused much damage to cotton in various districts of the Punjab, and the life and seasonal history have been studied at Khanewal. The eggs are laid singly usually on the underside of the leaf. They hatch out in 4-6 days in May-June. After feeding for 3-5 days on the leaf, the caterpillar turns over the corners of the leaf, secures them in position by means of silken threads, and lives and feeds inside this trumpet-like, rolled-up leaf. If disturbed the caterpillar drops to the ground, climbs up the plant again and prepares another roll. It enters into hibernation in October. Hibernation, as a rule, takes place in a cell made of material lying in furrows or on the surface of the soil in the cotton fields. Pupation generally takes place inside a rolled-up leaf. The pupal stage lasts for 11-22 days in March, 11-19 days in April, 6-10 days in May, 5-9 days in June, 5-7 days in July, 6-8 days in August-September, and 8-19 days in October. The adults live from 1-8 days. Mortality during hibernation period varies from 19·2 per cent. in February to 55·2 per cent. in April under field conditions. The moths emerge in about the first week in March. Other host plants include *Hibiscus esculentis*, *Abutilon indicum*, and hollyhock (*Althea rosea*). Some 36 species of birds are recorded as enemies of the cotton leaf roller, the most important being the Himalayan starling. Spiders, wasps, and black ants were also observed feeding on the caterpillars. Control measures suggested are: the destruction of all old cotton and other plants on which the pest breeds, hand-picking of infected leaves, ploughing of fields with a Raja plough, and dusting attacked fields with sodium fluosilicate, paris green mixed with ashes or fine road-dust in the ratio 1 : 8 by weight.

104. RÉCHERCHES ET TRAVAUX DE LA MISSION FRANÇAISE EN A.O.F. ÉTAT ACTUEL DU PROBLÈME DES ACRIDIENS MIGRATEURS EN AFRIQUE. By G. Bouet. (*Rev. Bot. App.*, 16, **173**, 1936, p. 1. From *Rev. App. Ent.*, xxiv., Ser. A, **4**, 1936, p. 237.) A general review, based on data from the literature, is given of the recent ecological research on locusts in Africa, with special reference to the work carried out in French West Africa under the auspices of the Algerian Committee for the Study of Locust Biology.

105. *Locusta migratoria migratorioides* R. and F.: An Ecological Reconnaissance of the Suspected Middle Niger Outbreak Area. By O. B. Lean. (*Bull. Ent. Res.*, 27, **1**, 1936, p. 105. From *Rev. App. Ent.*, xxiv., Ser. A, **4**, 1936, p. 234.) Studies were made of the river system, orography, climate, and vegetation of the area surveyed, the distribution of locust population by means of counts, and the breeding activities of ph. *solitaria*; and the characters of the various phases, in particular those that may be used in practice for distinguishing ph. *congregans* from *dissocians*, are given.

106. Effect of Solar Radiation and Micro-climate upon the Body Temperature and Behaviour of the Larvæ of *Locusta migratoria*. By I. D. Strel'nikov. (In Russian, with English summary.) (*Trav. Inst. Zool. Acad. Sci., U.S.S.R.*, 2, **4**, 1936. Abstr. in *Rev. App. Ent.*, xxiv., Ser. A, **5**, 1936, p. 312.)

107. Phase Variation and Rate of Development in the Algerian Race of the Migratory Locust (*Locusta migratoria*, L.). By B. P. Uvarov and A. G. Hamilton. (*Bull. Ent. Res.*, 27, **1**, 1936, p. 87. From *Rev. App. Ent.*, xxiv., Ser. A, **4**, 1936, p. 233.) The Algerian race of *L. migratoria*, although not known to occur in the gregarious phase in nature, can be readily transformed into almost typical ph. *gregaria* by breeding in crowded cages.

108. Rate of Locomotion in Relation to Starvation in *Locusta migratoria migratorioides* R. and F. By K. H. L. Key. (*Proc. Roy. Ent. Soc. Lond.*, (A) xi., **1-2**, 1936. From *Rev. App. Ent.*, xxiv., Ser. A., **6**, 1936, p. 396.) A special apparatus, which is described, was devised for measuring the speed of crawling adults of this locust under the directing influence of a beam of light. Insects subjected to periods of starvation of up to ninety-eight hours moved at the same average rate as normal control locusts—viz., 4·44 cms. per second at 27° C. (80·6° F.). [This represents a speed of 540 feet per hour.]

109. Étude sur la Sauterelle Migratrice *Nomadacris septemfasciata* Serv. et sa Présence à Madagascar de 1926 à 1935. By C. Frappa. (*Bull. Econ. Madagascar*, N.S. No. 3, 1935 p. 203. From *Rev. App. Ent.*, xxiv., Ser. A, **4**, 1936, p. 236.) The literature on the synonymy, general distribution and biology of *Nomadacris septemfasciata* is reviewed, and the records of this species from 1926 in Madagascar are given.

110. Récherches Expérimentales sur le Criquet Pèlerin. II. La Livrée Hibernale et les Migrations Réactivantes de la Phase Grégaire. By E. Roubaud. (*Bull. Soc. Hist. Nat. Afr. N.*, 26, **8**, 1935, p. 272. From *Rev. App. Ent.*, xxiv., Ser. A, **4**, 1936, p. 235.) Experiments with *Schistocerca gregaria*, Forsk., have shown that the adults cannot long support temperatures of from - 5° to + 10° C. (23-50° F.), but are very resistant to daily fluctuations ranging from - 3° to 55° C. (26·6-131° F.), which induce a diapause in sexual maturation and in general make the locusts more vigorous.

111. Studies on *Schistocerca gregaria* Forsk. By M. A. Husain *et al.* (*Ind. J. Agr. Sci.*, iii., **4**, 1933, p. 639; vi., **2**, 1936, pp. 188, 263; **3**, pp. 586, 591, 624, 665.) I. "The Micropyle in *Schistocerca gregaria* Forsk., and Some Other Acrididæ." II. "The Biology of the Desert Locust with Special Relation to Temperature." III. "Why Locusts eat Wool." IV. "Colour Changes and Sexual Behaviour in Desexualized *Schistocerca gregaria* Adults." V. "Pigmentation and Physical Exertion." VI. "Influence of Temperature on the Intensity and Extent of Black Pattern in the Desert Locust Hoppers Bred Crowded." VII. "Factors determining the Movement of Vermiform Larvæ."

112. Ainda Sobre os Inimigos de Gafanhoto Vermelho. By J. G. A. Cardoso. *Moçambique Docum, trim.*, 4, Lorenzo Marques, 1935. From *Rev. App. Ent.*, xxiv., Ser. A, 7, 1936, p. 444.) The various stages of a fungus, *Sterigmatocystis* sp., found on specimens of *Nomadacris septemfasciata* from Barue, Portuguese East Africa, where many locusts were dying from an unknown cause, are figured and described. Locusts fed on food containing the spores died a few days later, and it seems probable that this fungus was responsible for the epidemic. *Gregarina locustæ* was encountered for the first time in Mozambique infesting locusts, in October, 1935.

113. Conference on Co-ordination of Agricultural Research in the East African Territories held at Amani Research Station, February, 1936. The following memoranda were submitted in connection with cotton pests and diseases:

The Influence of Climate on Dysdercus spp. through their Wild Host Plants. By S. T. Hoyle (E.C.G.C., Nyasaland.) The number of stainers infesting the cotton crop is largely dependent on their transfer from wild hosts. Early rains develop the annual *Hibiscus* spp., whose population later transfers to cotton, and the same effect is produced by mid-season droughts, which affect Hibiscus more than cotton. Early planting is thus necessitated. The influence of arboreal host plants remains somewhat obscure.

The Influence of Climate on Dysdercus spp. through their Wild Host Plants. By W. Allan (Northern Rhodesia). Discusses the intimate relation between *Dysdercus superstitiosus*, the succession of wild *Hibiscus* spp. and cotton. At Mazabuka, cotton fills a gap between two species, and is severely attacked. In another locality the continuity of the wild hosts is unbroken, and cotton largely escapes in spite of the heavy stainer population existing. During prolonged dry weather stainers resort to local areas of thick bush in which they are able to survive. *D. fasciatus* is largely dependent on a single arboreal host, *Thespesia rogersii*. So long as there is an abundance of *Thespesia* fruit cotton is neglected, but when this is destroyed by natural enemies migration to cotton takes place.

Relation between Climate and Pests and Diseases of Cotton. By H. C. Ducker (E.C.G.C., Nyasaland). The view is put forward that in general where any pest or disease assumes the importance of a limiting factor to the production of a commercial yield, there is something wrong with either the variety, the cultural methods, or the environment in which the production is being attempted. Climate is an uncontrollable factor, and cotton growing can only be successful where it can be fitted into climatic conditions. Lack of adjustment is manifested in the prevalence of pests and diseases.

The Relation between Climate and Pests of Cotton in Northern Rhodesia. By W. Allan (Northern Rhodesia). Questions the validity of Mr. Ducker's general statement, especially in regard to insect attacks. In fertile acacia savannah country all the conditions favour a heavy crop were it not for the prevalence of bollworm and stainers. More promising results have been obtained under conditions less suitable except in respect of these pests. In Northern Rhodesia climatic variation is less important than differences in pest incidence.

114. Genetic Behaviour of a Mutant in a Trinidad Cotton Stainer (*Dysdercus urichi*). By S. C. Harland. (*Trop. Agr.*, xiii., **10**, 1936, p. 256.) A white nymphal mutant of a species of cotton stainer, *Dysdercus urichi*, native to Trinidad, proved on breeding tests to be a simple recessive to the normal form.

115. The Nature of Resistance in Cotton Plants to Stem-Weevil. By K. Dharmarajulu. (*Proc. Ass. Econ. Biol. Coimbatore*, 1935, p. 21. From *Rev. App. Ent.*, xxiv., Ser. A, **9**, 1936, p. 565.) Experiments show that the resistance of Cambodia cotton to attack by *Pempheres affinis*, Fst. takes two forms, the production of a gall and the exudation of gum. An account is given of the histology of these processes. The gall development took place in definite stages, the earlier ones following the general line of wound repair. The production of gum was directly dependent on the proliferation of tissue. The parenchyma of the callus disintegrated and flooded the gallery with the gum.

116. The Mouth-Parts of *Tetranychus telarius* and their Function with Regard to the Question of the Chemical Control of the Mite. By E. Bekker. (In Russian, with a summary in German.) (*Zool. Zh.*, xiv., **4**, Moscow, 1935. From *Rev. App. Ent.*, xxiv., Ser. A, **7**, 1936, p. 450.) A detailed description is given of the mouth-parts of *Tetranychus telarius* (Red spider), and their function is discussed. It is concluded that sucking is effected through a puncture in the leaf, and not from its surface, so that the mite would not be affected by stomach poisons. A study of its tracheal system, which is briefly described, indicated that respiratory poisons designed to penetrate through the tracheæ would be useless unless they also had a contact action on the tissues.

117. A Study of the Biology of the Flower Thrips *Frankliniella tritici* (Fitch), with Special Reference to Cotton. By J. G. Watts. (*Bull.* 306, *S. Car. Agr. Exp. Sta.*, 1936.) Of the eleven species of thrips found on cotton *F. tritici* is probably the most destructive. Life-history studies of the thrips were made through 65 generations. There was a decided variation in the duration of instars during various seasons, but the averages were as follows: egg, 3·31 days; first instar, 2·20 days; second instar, 2·80 days; prepupa, 1·13 days; pupa, 2·45 days, and total development 11·89 days.

Thrips injury to cotton in South Carolina was negligible after it had reached the age of about six weeks. All stages of this thrips are quite resistant to low temperatures. No insect parasites were found. The insidious flower bug (*Orius insidiosus* Say), the convergent lady beetle (*Hippodamia convergens*, Guerin), and a species of lacewing fly (*Chrysopa* sp.) are predatory enemies of the flower thrips. No practical insecticidal control is known at present, but improved cultural practices will prove of value in reducing population and injury.

118. Studies on *Bemisia gossypiperda*, M. and L. (White-fly of Cotton): Seasonal Activities in the Punjab. By M. A. Husain *et al.* (*Ind. J. Agr. Sci.*, vi., **4**, 1936, p. 893.) A study of the seasonal activities of *B. gossypiperda* shows that there are three phases of migration of the pest in the course of a year: (1) from cotton to the winter alternative hosts, (2) from there to the spring alternative hosts, and (3) from the latter back again to cotton. Cucurbits and ratoon cotton have been regarded as dangerous sources of infection for the new cotton. Period of quick multiplication of the pest coincides with that of germination and growth of the cotton crop. Severity of attack on cotton extends from June to August, on ratoon cotton till about the middle of July. During May relatively more eggs were laid on melons than on cotton, and from October onwards oviposition decreased on cotton and increased on *Brassica* sp., *Solanum tuberosum* and other host-plants. Infestation on weeds during the off-season of cotton has indicated that the pest may be checked by practising clean cultivation and removal of weeds.

[*Cf.* Abstrs. **455**, Vol. VIII. and **251**, Vol. XI. of this Review.]

119. The Scientific Principles of Plant Protection, with Special Reference to Chemical Control. By H. Martin. (Edward Arnold and Co., London, 1936, 2nd ed., 21s. From *Pl. Bre. Absts.*, vii., **1**, 1936, p. 121.) In a foreword by Sir Daniel Hall it is stated that the object of the study of plant diseases, as in the science of medicine, is to keep the subject in health rather than to treat its ailments. One of the most important ways of doing this is the breeding of resistant varieties. After a brief introduction on the general types of plant diseases and the different methods of control, the author discusses the phenomena of resistance, its inheritance and the methods of breeding varieties resistant to both plant and animal pests. Following upon this the various other methods of control are outlined. Each chapter is divided into sections, with a list of literature for each section, and the book terminates with a useful subject and author index.

[*Cf.* Abstr. **389**, Vol. VI. of this Review.]

120. THE STUDY OF IMMUNITY OF PLANTS TO INFECTIOUS DISEASES. By N. I. Vavilov. (Sel'khozgiz, Moscow and Leningrad, 1935. From *Pl. Bre. Absts.*, vii., **1**, 1936, p. 32.) The author reviews the extensive work that has been done in recent years on immunity in plants. The nature of immunity, natural and acquired, is first considered, and the factors affecting it are analyzed. The genetics of immunity and the breeding of resistant varieties are then discussed, and the view is expressed that the chances of success in breeding are directly proportional to the degree of specialization of the parasite on the one hand and of the host plant to be dealt with on the other. The monograph terminates with a selected and classified bibliography.

121. A NOTE ON A NEW TYPE OF PROGRESSIVE DAMAGE TO THE STRUCTURE OF COTTON HAIR CAUSED BY MICRO-ORGANISMS. By A. N. Gulati. (*Ind. J. Agr. Sci.*, vi., **3**, 1936, p. 861.) In an investigation of the causes of deterioration of Broach cotton a type of damage to the structure of cotton fibre was discovered which does not appear to have been previously described. The chief characteristics of this injury are that (1) it commences from the usual seat of organism infection—*i.e.*, the basal end, or a tear in any other part of the fibre; and (2) it slowly proceeds internally disintegrating and corroding the cell-wall, leaving intact merely the cuticular sheath. The injury caused to the structure of the cotton fibre is illustrated by nine photomicrographs.

122. COTTON SEED DISINFECTION EXPERIMENTS TO CONTROL BACTERIAL DISEASES OF THE COTTON PLANT. By T. Laycock. (*11th Bull. Dpt. of Agr., Nigeria*, 1932, recently received.) Various methods of disinfecting cotton seed to control bacterial diseases are discussed. Treatment of the seed with 1 per cent. germisan in a 0·2 per cent. solution of yellow soap in water proved successful in controlling bacterial disease, and had very little adverse effect on the germinating capacity of the seed.

123. SEROLOGICAL METHOD FOR THE DETERMINATION OF VARIETAL RESISTANCE TO DISEASE IN COTTON. By T. E. Fedotova. (In Russian, with English summary.) (*Pl. Prot. Leningrad*, v., 1935. From *Rev. App. Mycol.*, xv., **9**, 1936, p. 577.) Preliminary studies described in some detail showed that the globulin fraction of the albumin extracted from the seed of a number of varieties of *Gossypium barbadense*, *G. hirsutum* and *G. herbaceum*, reacted either positively or negatively with sera derived from rabbits sensitized by injection with cultures of *Verticillium dahliæ*, *Fusarium buharicum* and *Bacterium malvacearum*, according to whether the varieties were susceptible or resistant to attack by these micro-organisms in the field. There also were indications that the degree of susceptibility or resistance of the varieties could be fairly accurately estimated by the intensity of the reaction. A bibliography of 198 titles is appended.

124. INVESTIGATIONS ON BLACKARM DISEASE OF COTTON UNDER FIELD CONDITIONS. I. THE RELATION OF THE INCIDENCE AND SPREAD OF BLACKARM DISEASE OF COTTON TO CULTURAL CONDITIONS AND RAINFALL IN THE ANGLO-EGYPTIAN SUDAN. By F. W. Andrews. (*Emp. J. Exp. Agr.*, iv., **16**, 1936, p. 344.) From the results of investigations carried out during the two seasons 1932-34, it would appear that the infective debris on immediately adjacent cotton land of the previous season is the main cause of an outbreak of blackarm disease in the new crop. Driving rains are the vehicle of transmission of the disease from the old cotton land to the new, and the severity and frequency of these is an important factor in determining the final severity of the attack. The only effective method of control is to remove or render innocuous the infective material on the old cotton land; research is now concentrated on this aspect of the problem.

125. SOUTH CAROLINA: *Phytopathological Studies.* (*S. Car. Sta. Rpt.*, 1935. From *Exp. Sta. Rec.*, 75, **1**, 1936, p. 56.) Brief reports are included by C. H. Arndt on damping-off disease and the distribution of boll rots, varietal resistance to damping-off, cotton seed treatment, seed storage and the effects of origin of seed on the germination and internal infection by organisms, and laboratory tests with the anthracnose fungus *Glomerella gossypii* and other organisms.

126. ÉTUDE DES FACTEURS MÉTÉOROLOGIQUES RÉGISSANT LA PULLULATION DU *Rhizoctonia solani* KUHN SUR LE COTONNIER. By R. L. Steyaert. (*Publ. Inst. nat. Étud. Agron. Congo Belge*, Ser. Sci. No. 7, 1936. From *Rev. App. Mycol.*, xv., **9**, 1936, p. 578.) During the past two years cotton in the Belgian Congo has suffered from seedling damping-off caused by *Rhizoctonia* (*Corticium*) *solani*. Both micro- and macroscopically the fungus showed the characters of *C. solani*, the hyphæ being approximately 7·5 (up to 10) μ in diameter and the lateral branches emerging at right angles and being slightly constricted at the proximal end. The pseudo-sclerotia sometimes attained a diameter of 4 mm. Other hosts of *C. solani* in the Belgian Congo include *Canavalia ensiformis*, *Centrosema plumieri*, *Calopogonium mucunoides* (on all of which it produces leaf infections), *Crotalaria retusa* (on which the mycelium spreads up the stem, bringing about the death of the leaves), *Abroma augusta*, *Bidens pilosa*, carrot, and *Tagetes* sp. Two years' experiments made to ascertain the effect of meteorological conditions on infection showed that the chief factor in a tropical area is the amount of sunlight, which determines the soil temperature, a low soil temperature favouring an outbreak of the disease. Meteorological factors adverse to the seedlings are favourable to the fungus, and on the whole, the best period for sowing under the local conditions would appear to be from July 6th to 20th. Triumph cotton, which has become acclimatized, showed more resistance than recently introduced varieties. Seed disinfection in some cases gave very unsatisfactory results and is considered to be too expensive under Belgian Congo conditions. The most suitable control measures consist in improved cultural methods, shading, and soil aeration.

127. STUDIES ON THE ROOT-ROT DISEASE OF COTTON IN THE PUNJAB. II. SOME STUDIES IN THE PHYSIOLOGY OF THE CAUSAL FUNGI. By R. S. Vasudeva. (*Ind. J. Agri. Sci.*, vi., **4**, 1936, p. 904.) A synthetic nutrient medium equivalent to the composition of cotton roots is described, and the dependence of growth upon the most important constituents of the nutrient medium are discussed. Both *Rhizoctonia bataticola* and *Rhizoctonia solani* are moderately fast-growing fungi with optimum growth at 30° C. and have a wide range of toleration to acidity and alkalinity, that is between pH 2·4 and 9·2. Carbon dioxide has a depressing effect on both fungi. Upper thermal death points of *R. bataticola* and *R. solani* are very high, being 68° C. and 60° C. respectively. The parasitic activity of *R. solani* is increased in the presence of certain other fungi in the inoculum.

[*Cf. Abstr.* **307**, Vol. XIII. of this Review.]

128. BOMBAY: *Cotton Diseases*, 1934-35. By B. N. Uppal. (*Rpt. Dpt. Agr., Bombay*, 1934-35. From *Rev. App. Mycol.*, xv., **8**, 1936, p. 482.) From the summary of the report of the Plant Pathologist to Government, Poona, Bombay, we learn that *Macrophomina phaseoli*, either alone or in conjunction with *F. vasinfectum*, was isolated from hundreds of samples of Bombay cotton affected by root rot. The plants were found to contract infection readily at soil temperatures from 30° to 34°, but the manifestation of external symptoms seemed to depend on air temperatures.

129. TEXAS: *Phytopathological and Physiological Studies.* (*Texas Sta. Rpt.*, 1934. From *Exp. Sta. Rec.*, 75, **1**, 1936, p. 56.) Studies in connection with cotton root rot disease included the spread and persistence of *Phymatotrichum omnivorum* in its vegetative stage; nursery plants as possible carriers; persistence as affected by additions to the soil of fertilizers and other salts; the chemical composition of normal cotton roots and roots in various stages of decay from *Phymatotrichum root rot* and *Fusarium* wilt; the occurrence of field sclerotia in different types of soil; laboratory studies of the longevity of the sclerotia; fungi associated with *P. omnivorum* and the possible perfect stage; the effect of X-rays and of radium on *P. omnivorum*; the composition of soils from root rot and non-root rot areas in the same field; the susceptibility of California wild cotton to root rot; *Bauhinia purpurescens* as a new host of *P. omnivorum*; control of root rot by long rotation with sorghum; effect of flooding on its control; graminaceous barriers and sulphur slabs to prevent the spread of the fungus; preliminary field trials with pentachlorethane, tetrachlorethane, and xylene for the eradication of root rot, and their effect on host plants; the effect of cotton wilt on the quality of the lint and seed.

130. PRELIMINARY OBSERVATIONS ON SMALL-LEAF DISEASE IN COTTON. By V. P. Gokhale. (*Ind. J. Agr. Sci.*, vi., **2**, 1936, p. 475.) The disease is widespread and affects cottons of the *Herbaceum* type; no *Neglectum* types have been infected. The severity of attack varies from year to year. In the Kaira district the disease is serious in the first and second ratoons, though the crop in the first year is free from it. The damage to the second ratoon may be as high as 35 per cent. No evidence has been obtained that parasitic organisms are associated with the diseased plants, nor does the disease appear to be caused by insects or by soil or climatic conditions. It was not transmitted to healthy plants by insects taken from naturally infected plants nor by the juice expressed from the diseased plants. Experiments on the transmission of the disease by grafting were inconclusive.

131. STUDIES IN DISEASE RESISTANCE. I. *Cotton Wilt and Environment.* By K. N. Ambegaokar and Y. D. Wad. (*Proc. of Ind. Acad. of Sci.*, iii., **6**, 1936.) The investigations indicate that the incidence of wilt for both susceptible and resistant varieties may be influenced by several environmental conditions. Actual wilting of the plant is not due to insufficient soil moisture. Soil around the roots of wilted plants contained a higher percentage of bound water than that around the roots of healthy plants. Root activity was less in wilted plants, and their death-rate always exceeded the fresh production of active roots in the upper 18 inches of the profile. This reduced activity was reflected in reduced yields. It was found that the incidence of wilt was affected by changes in nutrient supplied, but this influence was modified by soil conditions and requirements of the variety, thus explaining the inconclusive results usually obtained in manurial trials to control wilt in the field. Though sometimes nitrogenous manures appeared to increase wilt incidence, the nitrogen content of leaves of wilted plants was always found to be lower. The apparent association of an abrupt rise in sunlight duration with increased wilt incidence is perhaps connected with low nitrogen content. Sudden increase in photo-synthesis may lead to exhaustion of the vital proteins to a greater extent than their recuperation.

Low nitrogen content of leaves of the wilt-affected plants may also disturb the balance of protoplasmic proteins, leading to partial disintegration even in the absence of a change in the rate of photo-synthesis. How far the lowering of nitrogen in leaves is a result of inability of the plant to absorb soil nitrogen, or is due to its being intercepted by the fungus on its way to the leaf, remains uncertain. Further work is needed to determine how and to what extent the fungus or the plant, or both, are responsible for the observed modifying influence of environment on wilt-incidence. It is clear, however, that while investigating the possibility of wilt-control by soil management, the plant and the fungus can be treated as one system.

II. *Leaf-roll and Red Leaf of American Cottons.*—I. Madhusudan Rao and Y. D. Wad. (*Proc. of Ind. Acad. of Sci.*, iii., 6, 1936.) Leaf-roll and red leaf disease of American cottons is described. Results of pot-culture experiments indicate that it may develop under different atmospheric environments, provided the soil surface becomes puddled after prolonged saturation. These bad soil conditions appear during the monsoon period in Malwa and later in Rajputana. Accumulation of salts found in the upper layers of soil around the diseased plants shows the poor permeability of these layers. Death-rate of roots of diseased plants in the upper layer of soil was found to be too high to be compensated by the rate of active-root production. The total active root-length of diseased plants in the lower zone was less than that of the healthy plants. Whether this reduced root-activity of diseased plants is due to the lowering of respiration or to a change in nutrient supply, or both, remains to be investigated. The resultant effect seems to be an upsetting of the balance of growth as seen by lower sap concentration and nitrogen content of the diseased leaves. If the disorder starts early the yield is seriously affected; if it appears later, the quality of the lint is affected. Soil deterioration during the crop season would appear to be the deciding factor favouring the disease. Suitable treatment of the soil to enable it to maintain its fertility at a high level throughout the cropping period (as shown by small plot tests) promises to overcome the malady.

132. NOTE SUR LE PARASITISME DU *Macrophomina phaseoli* (MAUBL.) ASHBY. By J. A. Sarejanni and C. B. Cortzas. (*Ann. Inst. Phytopath., Benaki, Greece*, i., **3**, 1935. From *Rev. App. Mycol.*, xv., **9**, 1936, p. 577.) In October, 1934, cotton plants of the native variety Dadiotico (*Gossypium herbaceum*) were observed in various localities in Greece to be wilted as a result of attack by *Macrophomina phaseoli*. The sclerotia measured 45 to 150 by 45 to 120 μ, and are therefore referable to Haigh's group C. In the affected cotton fields the fungus killed from 5 to 40 per cent. of the fully grown plants. Histological examination of diseased material showed that the phelloderm was not attacked by the mycelium, which apparently effected its entry through cracks in this tissue and destroyed the cells but not the fibres of the liber. It then spread to the wood. In American varieties, which though growing in the infected area had remained unaffected, the phelloderm was much thicker than in the Dadiotico variety, and this fact may explain the absence of the disease on cotton in the United States. A list is given of 93 plants on which *M. phaseoli* has so far been recorded.

GENERAL BOTANY, BREEDING, ETC.

133. ZÜCHTUNG DER BAUMWOLLE. By L. P. Bordakov. (*Z. Zücht.*, A. 21, 1936. p. 68. From *Pl. Bre. Absts.*, vii., **1**, 1936, p. 65.) A review of the literature on the genetics of cotton.

134. THE GENETICS, BREEDING AND SEED PRODUCTION OF COTTON. (*Sredaz NIHI Cent. Breeding Sta.*, pubd. by Sel'khozgiz, Moscow and Leningrad, 1933. From *Pl. Bre. Absts.*, vii., **1**, 1936, p. 65.) A description of the morphology, anatomy and development of the cotton plant, of the reproductive organs, and of the lint. In the section on classification, the view of Zaitzev that the four groups of cottons established by him are quite independent and have no intermediate forms, is shown to be untenable, and even the groups differing in chromosome number are now known to be capable of crossing and giving partially fertile hybrids. In the section on genetics, the range of variability of different economic characters in the cotton plant is discussed; the inheritance of certain qualitative characters is also described, such as dehiscence and non-dehiscence of bolls, brown colour of lint, petal spot and form of leaf. A brief history is included of the development of cotton breeding in the Soviet Union, and descriptions are given of the varieties of cotton grown, including the newest improved selections of the Soviet breeders. The work closes with chapters on seed production and control and on methods of cultivation.

135. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation, price 2s. 6d., post free.) The thirteenth number of Series A Genetics has recently been issued, and contains the following paper reprinted from the *Journal of Genetics*:

THE GENETICS OF COTTON, Pt. XVI.: "Some Observations on the Inheritance of Form and Size in Asiatic Cottons," by J. B. Hutchinson. The results described show clearly the many different types of inheritance involved in the control of form in cotton. Simple inheritance of allelomorphic genes affecting only the rate of growth at right angles to the main leaf veins is matched by a group of genes of small individual effect influencing all foliar organs. In plant habit the controlling mechanism differs so greatly between species that the normal habit correlations are broken down in interspecific crosses, though individual genes, so far as they can be studied through their linkage with simply inherited characters, behave in the same way whether the cross is within or between species. The work of Rasmusson is supported by the demonstration that there is a general interaction between individual genes affecting node numbers and the rest of the node number component of the genotype, so that the magnitude of the factor difference depends upon the position in the node number range at which it occurs. The simple nature of the inheritance of the main leaf-shape difference, and the demonstration of widely different population compositions in neighbouring areas leads to the hope that valuable information can be gained concerning the selective values of form factors in crops at present untouched by the plant breeder.

136. DUPLICATE GENES FOR COROLLA COLOUR IN *Gossypium barbadense* L. AND *G. Darwinii* WATT. By S. C. Harland. (*Z. indukt. Abstamm.-u. Vererb-Lehre*, **71**, 1936, p. 417. From *Pl. Bre. Absts.*, vii., **1**, 1936, p. 67.) The twenty-six chromosome species of cotton *G. Darwinii* Watt., endemic in the Galapagos Islands, has been fully investigated and the results will be published elsewhere. In the present note the author deals with the genetics of the corolla colour. Crosses between *G. barbadense* and *G. Darwinii*, both with bright yellow corolla, gave an all yellow F_1, but in the F_1 and F_2 back-crossed to recessive white a number of white and cream plants occurred, indicating the existence of duplicate genes which are designated as Y^B (*barbadense*) and Y^D (*Darwinii*) and making the fourth case of duplicate genes recorded in the amphidiploid New World cottons.

137. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation, price 2s. 6d. each, post free.) The eighth and ninth numbers of Series B, Physiology, have recently been published, and contain the following papers reprinted from the *Annals of Botany*:

MEMOIR NO. 8. (*a*) "The Concentration of Solutes in Sap and Tissue, and the Estimation of Bound Water." By T. G. Mason and E. Phillis. Estimates of the weight of chlorine in the leaf of the cotton plant, calculated from the concentration in the expressed sap and the weight of water in the leaf, exceed by more than 10 per cent. estimates based on the weight of chlorine in the oven-dried material. Similarly, the sap estimates of the weight of sugar in the leaf exceed estimates based on alcoholic extraction. Likewise, the concentrations of chlorine and sugar in the *sap* exceed the concentrations in the whole tissue, the latter being calculated from the weights of chlorine and sugar in the whole tissue and the weight of water found by drying the tissue to constant weight at 100° C. As there is no indication of the presence of bound water in the expressed sap, using the cryoscopic method, it is suggested that the reason for the discrepancy in the sap and tissue estimates is due to the presence of bound water in the tissue. This suggestion is reinforced by the observation that the concentration of chlorine in the residue left after sap expression is much less than in the expressed sap. The concentration of sugar in the residue after pressing is vitiated as a result of hydrolysis of polysaccharides. It is pointed out that the *weight* of sap-soluble potassium, and probably the weight of many other sap solutes, cannot be determined by leaching the powdered oven-dried material, or by hot water extraction, owing to the presence of adsorbed potassium, etc., which are released by heating. It is calculated that about 25 per cent., of the total potassium is not in solution in the cell sap. It is also emphasized that the *concentrations* of sugar and chlorine in the intact plant are best obtained on sap expressed from frozen tissue; possibly the concentrations of the solutes could also be obtained by correcting the tissue concentrations for bound water by means of the calorimeter or dilatometer. No evidence of the adsorption of sucrose or chlorine has been obtained.

(*b*) FURTHER STUDIES ON TRANSPORT IN THE COTTON PLANT, Pt. V.: "Oxygen Supply and the Activation of Diffusion." By T. G. Mason and E. Phillis. 1. When the petiole of a leaf was coated with paraffin wax, carbohydrate accumulated in the lamina in excess of the normal amount. This accumulation could be detected within twenty-four hours of the operation of applying the wax, but after a few days the amount declined below that in leaves whose petioles were not coated with wax. There was, at the same time, an accumulation of carbohydrate, phosphorus, and doubtless other phloem mobile mineral elements in the petiole. The interpretation of the experiment is complicated by the fact that there may be a great loss of all the phloem mobile mineral elements from the lamina. It is concluded that this type of experiment, in which the rates of carbohydrate production and of arrival of the mineral elements in the lamina are known, while leading to results that are in harmony with the view that curtailment of air supply to the petiole leads to a partial block in transport, is nevertheless ill-adapted to determining the role, if any, of oxygen in support.

2. (*a*) A reduction in air supply to a region of bared stem may bring about a check (25 per cent.) in transport through it. On the other hand, transport may not suffer any check. It is considered possible that when oxygen supply through the lenticels is reduced, oxygen may be obtained from the transpiration current and that the extent of the check in transport depends on the oxygen supplying power of the transpiration current.

(*b*) Growth in the region of stem from which air was excluded was checked to a much greater extent than transport through it. It is concluded from this that either the oxygen requirements for growth exceed those for transport or that the oxygen potential of the sieve-tube is stepped up as a result of the activity of the companion-cell. The compact nature of the phloem and localization of a peroxidase leptomin, in the sieve-tube and companion cell, prompts the suggestion that a carrier of oxygen may be a factor in the oxygenation of the sieve-tube.

3. Prising apart wood and bark over a short distance of stem and coating

the inner and outer surfaces of the isolated bark with material (*e.g.*, vaseline, varnish, oil) to exclude air from it, led to a great (up to 100 per cent.) reduction in the rate of transport through it.

4. (*a*) Observations were made on the effect of a thick coat of plasticine applied to a completely defoliated branch, on the rate of transport of carbohydrate and a number of mineral elements into the young seeds situated in a fruit at the end of the branch. Two lengths of branch were covered with plasticine, a Short group of 6 inches and a Long one of 12 inches. It was assumed that the movement of water through the xylem would be greatly reduced as a result of defoliation.

(*b*) It was found that the movements of carbohydrate and of nitrogen were equally checked, and that the movements of phosphorus, of potassium, and of magnesium were also checked to about the same extent as one another, but that the check for the first group was somewhat greater than that for the second. Possible explanations of the difference are discussed.

(*c*) It was also found, taking nitrogen as the indicator of transport, that doubling the length of stem covered with plasticine diminished the amount of material transported in approximately geometrical progression. It is pointed out that this would occur if the degree of oxygen starvation was the same throughout the length of stem covered with plasticine, and if the acceleration of diffusion was the same in the two halves of the Long group as in the Short one. It is suggested that the mechanism activating diffusion consists in some special organization in the cytoplasm, maintained by metabolic energy, whereby the resistance to solute movement is so reduced that materials diffuse in the sieve-tube at rates comparable with those in a gas.

As pointed out in an earlier paper of this series (Pt. III., " Concerning the Independence of Solute Movement in the Phloem "), no calculation of the energy needed to expedite diffusion in the sieve-tube seems possible. At first sight it would appear that the energy requirements would be prodigious and could not be furnished by the carbohydrate present. It should, however, be stressed that the relation of solute to solvent in the cytoplasm and in water may be different. There are some grounds for the belief that the solubility of sucrose in the sap varies from one tissue to another. Moreover, little as yet seems to be known concerning the combination of simple diffusion processes with surface conditions, and nothing is known concerning the combination of simple diffusion processes with surfaces kept active by respiration.

MEMOIR NO. 9. FURTHER STUDIES ON TRANSPORT IN THE COTTON PLANT, Pt. VI.: " Interchange between the Tissues of the Corolla." By E. Phillis and T. G. Mason. During the night preceding anthesis, nitrogen, phosphorus, potassium, magnesium and chlorine are imported into the corolla and during the succeeding night these elements are exported. The bulk of the materials exported travel through the peduncle to the parent fruiting branch. Reasons are given for believing that both import and export take place through the phloem. The sap concentrations remain low while import is proceeding and rise during the day of anthesis prior to export. The rise in concentration is due in part to conversion of insoluble to soluble materials, and in part to a drying out of the tissues of the corolla. As materials are exported from the corolla to the fruiting branch, and as the concentrations are much larger in the bark of the fruiting branch than in the corolla, it is inferred that gradient considerations alone are not responsible for the change in the direction of movement in the corolla. The attempt to explain the reversal of the direction of transport in terms of a change in the activity of the transition cells was not successful. As the parenchyma between the veins turns from yellow to red and wilts just before export begins, while the veins remain yellow and turgid, it was suggested that the cause of the reversal of the direction of transport should be sought in the parenchyma between the veins rather than in the vein and its phloem. Re-examination of some of the data presented in a recent paper on carbohydrate transport indicates that the distribution of sugar between tissues conforms to the law governing the partition of a solute between liquids with different solvent capacities. The reversal of the direction of transport in the corolla is explained as follows: Solutes move between the phloem and the parenchyma between the veins to maintain the distribution determined by the relative solvent capacities of the two tissues. Continued movement from the phloem into the parenchyma is ensured during development by the maintenance of low concentrations as a result of utilization and of the intake of growth water. After anthesis the cessation of utilization would lead to a cessation of import. With the onset of protoplasmic decomposition and the drying out of the tissues, the concentration in the parenchyma rises and solutes move back into the phloem. If the solvent capacity of the parenchyma declines with age, another factor promoting export from the parenchyma would be introduced.

138. STUDIES IN PLANT BREEDING TECHNIQUE. I. AN ANALYSIS OF THE EFFICIENCY OF SELECTION METHODS USED IN THE IMPROVEMENT OF MALVI COTTON. By J. B. Hutchinson and – Kubersingh. (*Ind. J. Agr. Sci.*, vi., **3**, 1936, p. 672.) The aims, methods, and achievements of selection in Malvi cotton are summarized. Two strains superior to the local mixture in all characters have been isolated and are being distributed. The methods and achievements of selection are analyzed, and it is concluded that on the whole the changes ascribable to selection have been disappointingly small in spite of the superiority of the finally selected strains. Data from randomized, replicated progeny-row experiments on the selected strains are summarized, and show clearly that the methods of selection adopted were not sufficiently critical to detect a large amount of genetic variance which was present in the material. The advantages for selection work of replication and randomization of progeny rows are pointed out. The success achieved is ascribed primarily to the breeder's judgment and not to the selection methods. The paramount importance of the breeder's art is emphasized, and it is pointed out that no improvement in selection technique will free him from the need to gain that familiarity with his material which makes the successful exercise of his judgment possible.

139. THE IMPORTANCE OF THE LOCAL COTTONS OF AFGHANISTAN FOR PRACTICAL BREEDING WORK IN THE U.S.S.R. By L. P. Bordakov and M. M. Ivanova. (*Bull. Appl. Bot., Leningrad*, 1935, Ser. A., **16**, p. 79. From *Pl. Bre. Absts.*, vii., **1**, 1936, p. 68.) The Afghan cottons, mostly belonging to *Gossypium herbaceum*, are of interest in breeding on account of their closed bolls (of value for mechanical harvesting and in windy districts), some of which are very large and contain long, white, silky lint, varying from 15 to 30 μ in length, with a ginning outturn of over 25 per cent. They appear to be drought-resistant, and are not subject to shedding. Their general high quality and range of variation make this species worthy of much more attention. Other interesting characters occurring in the group are the absence of petal spot, principally in the region of Herat, exceedingly early forms near Kabul, and peculiar forms with the tips of the valves bent down. The characteristics of the cottons of different parts of the country are described and illustrated; many features are pointed out in which they resemble the local cottons of Central Asia, and it is suggested that the latter are derived from Afghanistan, contrary to the reverse opinion expressed by Zaitzev and others. These forms are mainly found in the foothills, and the closed-boll forms are concentrated in the high mountains in the neighbourhood of Herat. Here there is a remarkable variety of forms of this type, some of which are highly valuable from the point of view of their long silky fibre, and the region is obviously a very ancient centre of these cottons. They are to be used extensively in breeding. The cottons of other species found in Afghanistan are apparently of an adventive nature.

140. IMMATURITY IN NORTHERN NIGERIAN COTTON. By J. K. Mayo. (*11th Bull. of Dpt. of Agr., Nigeria,* 1932, recently received.) The possible causes of immaturity in Allen cotton are discussed.

141. A PRELIMINARY NOTE ON COTTON FAILURE IN THE PUNJAB AND SOME ABNORMALITIES IN THE PLANT. By R. H. Dastur. (*Ind. J. Agr. Sci.,* vi., **2,** 1936, p. 377.) Micro-chemical study of American cottons grown in the Punjab and other places in India has revealed some abnormal features not previously noticed. Disintegration of the chloroplasts in green and healthy-looking leaves is first noticed. In the cortex of the roots small yellow masses appear each containing minute bodies which rapidly become brown. Such minute bodies have also been noticed in the cotyledons of the seed and the foliage leaves. They collect in the cortical, phloem and other conducting parenchymatous cells, and first form small or large colonies which later lose their granular appearance, and become semi-liquid in nature. These bodies react with the starch grains in the cells of the cortex, with medullary rays and xylem parenchyma, and ultimately form complex deposits of substances which give the reactions of proteins, fats and tannins. Such deposits are produced in all the cells, except the xylem vessels of the roots, stems and branches. Micro-organisms in the form of bacteria have been cultured from the leaf, stem, root and the embryo of the seed of the plant. They are different from the organism which causes black-arm disease of cotton. These abnormalities are found in more than fifty different strains of cotton, exotic or indigenous, so far examined; there are also a few strains that are free of them.

142. A NOTE ON THE HAIRINESS OF COTTON. By M. Afzal. (*Ind. J. Agr. Sci.,* vi., **3,** 1936, p. 823.) Degree of hairiness of American cottons is a character, the measurement of which is very important under Punjab conditions, as hairiness is supposed to be associated with resistance to jassid attack. No American variety can be recommended for general cultivation unless it is tolerably resistant to this pest. All indigenous varieties of cotton are very hairy, and are not injured by jassid. The hypocotyledonary region of all American varieties so far examined is devoid of hairs, while that of Mollisoni has 15 hairs per sq. mm. The cotyledons, on the other hand, of both Desi and American cottons are absolutely glabrous. It has also been found that leaves produced high up on the main stem are more hairy than those produced lower down. This is an important finding, since it explains in some measure the discrepancies in the genetic analysis of this character reported by several workers.

143. POSITIONS OF SEEDS AND MOTES IN LOCKS AND LENGTHS OF COTTON FIBRES FROM BOLLS BORNE AT DIFFERENT POSITIONS ON PLANTS AT GREENVILLE, TEXAS. By D. D. Porter. (*U.S. Dpt. Agr., Tech. Bull. No.* 509, 1936.) The following conclusions are presented as the result of studies of variations in some of the seed and fibre characters of ten varieties and strains of cotton commenced at Greenville, Texas, in 1931:

When all ovules in a carpel develop into mature seeds the lock contains no motes, but if one or more of the ovules abort before development is complete the number of mature seeds in the lock is reduced. Since approximately one-third of the motes found in the cotton were located at the base of the lock, and the remainder in decreasing numbers toward the apex, it would appear that the causes of abortion are more active near the base of the lock. The seed with the longest fibres may occur at any position in a lock of cotton; evidence from a total of 900 locks, covering three crop seasons, indicated, however, that as a rule the shortest fibres occur on seed at the apex of the lock, longer fibres on seed at the base, and the longest fibres on seeds in the central portion of the lock. At Greenville there was a definite tendency for locks with few seeds to produce fibres of greater length than are produced by locks having large numbers of mature seeds; it is probable that the cause of the tendency to produce longer fibres in locks with fewer seeds is a nutritional one.

144. THE EXPERIMENTAL PRODUCTION OF HAPLOIDS AND POLYPLOIDS. (*Imp. Bur. of Plant Genetics, School of Agr., Cambs.*, 1936.) The compilation of this bibliography by the Imperial Bureau of Plant Genetics, Cambridge, was the outcome of a request from a correspondent for references on the experimental production of haploids. An examination of the files showed that the query could not be satisfactorily answered without further researches into the literature, and in so doing the full extent of the subject was revealed as worthy of treatment in some detail. The scope was enlarged to include polyploids, as these are not easily separated from the problem of haploidy. References are also made to non-economic plants, especially *Œnothera*; though these are by no means complete, yet the importance of their contribution to the subject makes it impossible to neglect them in a work of this kind. Time did not permit of a consideration of polyploidy in other than the flowering plants; work done on ferns and mosses had to be omitted. Certain Russian papers bearing on the subject referred to in Russian publications have not yet been published, and could not, therefore, be included.

145. HAPLOIDS IN POLYEMBRYONIC SEEDS OF SEA ISLAND COTTON. By S. C. Harland. (*J. Hered.*, **27**, 1936, p. 229. From *Pl. Bre. Absts.*, vii., **1**, 1936, p. 67.) Seeds containing two embryos were found in the Sea Island strain V. 125, and when sixteen of the pairs of plants were raised to maturity fourteen pairs were found to consist of one haploid and one diploid plant. It is suggested that this polyembryonic haploidy is the cause of the one haploid in three or four thousand plants which occurs in commercial fields of Sea Island cottons. Haploids have also been reported in Upland cotton (*Gossypium hirsutum*, L.), and in the strains from crosses between *G. hirsutum* and *G. barbadense*. The Sea Island haploids show a certain amount of fertility on the female side, varying according to the strain from which they arose. One haploid set practically every boll when pollinated by normal Sea Island pollen, and even with pollen from the 13 chromosome species *G. arboreum*, *G. harknessii*, *G. armourianum*, *G. anomalum*, *G. tribolum* and *G. aridum*. The two recorded Upland haploids were completely sterile. The value of the haploids in breeding lies in the stable background they provide for back-crossing work, when maintained by vegetative propagation. Although repeated back-crossing of a diploid to the haploid may not reduce heterozygosity any faster than self-fertilization, the stable genotype of the haploid provides a base towards which the product of repeated back-crosses continually converges, and if desirable characters can be obtained in a haploid—*e.g.*, from a cross between *G. hirsutum* and *G. barbadense*—their incorporation in a diploid would be ensured by this method. A further advantage is that undesirable recessives can be detected by inspection in the haploid. Crosses of Sea Island cotton with 13-chromosome species are likely to be more easily produced when the haploid ($n=26$) is used as the female parent. It was hoped by such crosses that the two sub-genoms of the amphididiploid *G. barbadense* might be separated, but so far the crosses of 13-chromosome species with both haploid and diploid Sea Island cottons have been identical. It is suggested that polyembryony in Sea Island cotton may be due to some genetic disharmony, arising from the meeting of two unlike genoms in this amphidiploid form.

146. THE AMOUNT OF HETEROZYGOSIS TO BE EXPECTED IN AN APPROXIMATELY PURE LINE. By J. B. S. Haldane. (*J. Genet.*, **32**, 1936, p. 375. From *Pl. Bre. Absts.*, vii., **1**, 1936, p. 2.) Two sources of heterozygosis are considered, namely, that retained from the original ancestors and that due to mutation. The respective amounts of heterozygosis due to these two causes are calculated for selfed diploids, including autosomal and sex-linked genes, and selfed autotetraploids.

147. DIFFERENTIAL CHROMOSOME STAINING AT MEIOSIS IN *G. Peruvianum*. By J. Ellenhorn. (In German). (*Cytologia*, **7**, p. 213. Tokyo, 1936. From *Pl. Bre. Absts.*, vii., **1**, 1936, p. 67.) In pollen mother cell preparations of a New World cotton fixed in Navaschin's fluid and stained with iron alum-haematoxylin there were to be seen at second metaphase thirteen deeply stained and thirteen lightly stained chromosomes, the regularity and certain other features of the phenomenon betokening a real difference between the two sets. It is suggested that this difference is in the nature of amphiplasty. Secondary pairing was observed, in which 24 of the 26 chromosomes participated, and was always between similarly stained chromosomes. The results are taken to confirm the hypothesis that the New World cottons are modified octoploids.

148. SECTION CUTTING BY A MODIFIED PLATE METHOD. By J. M. Preston. (*J. Text. Inst.*, xvxii., **8**, 1936, T216.) Modifications of the technique of the plate method of cutting fibre sections are described, which enable the method to be used for dark coloured fibres and raw cotton hairs.

149. HOPI × ACALA COTTON: QUALITY. (*Text. World*, **86**, 1936, p. 1488. From *Summ. of Curr. Lit.*, xvi., **18**, 1936, p. 498.) Hopi cotton, grown by the Hopi Indians in N.E. Arizona, has been crossed with Acala, giving a 1⅛ inch cotton of fine, silky lint. In tests, it is spun to finer counts than Upland, giving yarn as strong as that from 1½ inch Upland.

FIBRES, YARN, SPINNING, WEAVING, ETC.

150. GRADING RAW COTTON. (*Text. Rec.*, liv., 641, 1936, p. 25.) Indicates how the polarising microscope can assist the spinner to determine the maturity of cotton fibres.

151. RAW COTTONS: EVALUATION. By D. de Prat. (*L. Ind. Text.*, **53**, 1936. From *Summ. of Curr. Lit.*, xvi., **18**, 1936, p. 520.) A review of modern scientific methods for the determination of the spinning value of raw cottons.

152. INDUSTRIAL FIBRES. (Printed and Pubd. for the Imperial Economic Committee by *H.M. Stat. Off.*, 1936. Price 2s. 6d. net, 2s. 9d. post free.) A summary of figures of production, trade, and consumption relating to cotton, wool, silk, flax, jute, hemp and rayon, compiled in the Intelligence Branch of the Imperial Economic Committee. In connection with cotton, statistics are given of acreage, unit yield, production, cotton varieties, end-of-season stocks, exports, imports, mill consumption, prices, from 1928 to 1935.

153. COTTONSEED LINT: DETERMINATION. By R. S. McKinney and G. S. Jamieson. (*Oil and Soap*, **13**, 1936, p. 139. From *Summ. of Curr. Lit.*, xvi., **19**, 1936, p. 549.) A method for estimating lint on cotton seed is described, n which the lint is destroyed by "fuming" with hydrochloric acid at 130° C. Duplicate determinations agree within 0·2 per cent., and are comparable with plant yields. A further method is also outlined by which the proportions of hulls and cellulose in "hull fibre" can be calculated.

154. Spinning Problems: Discussion. Southern Textile Association. (*Cotton*, U.S., v., **100**, 1936, pp. 75-81, 84-86, 155. From *Summ. of Curr. Lit.*, xvi., **16**, 1936, p. 444.) In connection with North Carolina the following topics were discussed among others: *Humidity in carding* : 55 per cent. R.H. was recommended for raw cotton and more for coloured stock. *Setting cork-covered rollers :* The question was raised whether rebuffed rollers should be set closer, but general opinion was that nothing was to be gained thereby. *Humidity in high-draft spinning :* General experience was that a higher R.H. was necessary than for ordinary spinning.

East Carolina.—A discussion on the value of routine testing in spinning is reported, the following points being raised: Determination of the best opener and scutcher settings; setting laps back; changes in card drafts, speeds and settings; use of the sliver tester; testing the twist in roving; and making end-breakage tests in spinning.

South Carolina.—A report of a general discussion, including the following points; the use of roller-bearing spindles; change of ring from 1¾ inches to 1⅞ inches, and the elimination of separators on a 3½ inch gauge frame; running humidifiers in spinning over the week-end; making 30's warps from a single intermediate roving; the causes of sloughed-off weft: the necessary amount of taper on a weft quill; detecting the causes of bad running work; the difficulty of travellers flying off after oiling; methods of buffing and changing cork rollers.

155. Cotton and Spinning Machinery : Testing. By R. J. McConnell. (*Cotton*, U.S., v., **100**, 1936, p. 82. From *Summ. of Curr. Lit.*, xvi., **16**, 1936, p. 443.) A general description is given of the procedure adopted at the Whitin Machine Works for spinning tests on cotton and of the laboratory equipment for testing the performance of new machines.

156. Spinning Room: Value of Controlled Humidity. By A. W. Thompson. (*Text. World*, **86**, 1936, p. 1266. From *Summ. of Curr. Lit.*, xvi., **16**, 1936, p. 444.) A graphic method is described and illustrated that has been devised for recording and visualizing the effect of variations in humidity on textile processing. The records demonstrate the value of controlled humidity in spinning.

157. Cotton Spinning Mill: Organization. By G. R. Merrill. (*Text. World*, **86**, 1936, p. 1062. From *Summ. of Curr. Lit.*, xvi., **14**, 1936, p. 397.) Deals with the organization of waste and ordinary cotton spinning. Two tables are given showing a range of drafts, lap weights, hank numbers, etc., and the counts spun from various staples.

158. Cotton Processing. By F. Chadwick. (*I.R.I. Trans.*, ii., 1936, p. 550. From *J. Text. Inst.*, xxvii., **9**, 1936, A422.) A description of the preparation, spinning, and weaving of cotton, with special reference to the rubber trade requirements. Recent experiments are referred to in which the changes in break load and elongation of cord fabric, stored under conditions of controlled humidity, were determined.

159. The Use of Cotton Fabric in Road Making in America. By R. I. Cheatham and R. Whitaker. (*Text. Rec.*, lix., **642**, 1936, p. 25.) Preliminary tests in the use of cotton fabric in road-making having proved successful these are being continued on a larger scale. Experiments are being carried out with a view to producing the fabric best suited for the purpose.

160. A New Baling Press. (*Int. Cott. Bull.*, xiv., **56**, 1936, p. 472.) Describes a new machine by Messrs. Hindle, Son and Co., Ltd., Blackburn, designed to accommodate bales up to 2 cwt. It is fitted with a double rack and pinion device, thus distributing the pressure equally over the whole surface of the platen.

TRADE, PRICES, NEW USES.

161. ANNUAL COTTON HANDBOOK, 1936. (Compiled and published by Comtelburo, Ltd., London, E.C. 2. Price 5s. 2d., post free.) We have received a copy of the sixty-sixth edition of this useful publication for recording daily the receipts and quotations of American, East Indian, and Egyptian crops. Many statistical tables are also included in the volume. A sign of the times is the addition of tables showing the imports of Indian cotton into England. A table is also provided showing the highest and lowest futures prices for " American and other growths," trading in this contract commencing on January 2, 1936.

162. COTTON SUPPLIES AND PRICES. By W. H. Slater. (*Text. Wkly.*, **18**, 1936, p. 335. From *Summ. of Curr. Lit.*, xvi., **21**, 1936, p. 638.) American and World statistics of cotton production and stocks for the 1935-36 season are analysed. The influence of "outside growths" during the period of crop restriction and drought in the United States is commented upon. Predictions are tabulated of prices for the 1936-37 season; a considerable rise is expected.

163. THE RISE IN WORLD COTTON CONSUMPTION. By D. Windel. (*Man. Guar. Coml.*, 7/8/36.) The outstanding feature in the cotton season just ended was the remarkable expansion in the world rate of cotton consumption. Despite international political and monetary uncertainties world trade continued slowly but steadily to recover. Textile mill activity in many countries, particularly the United States, Great Britain, and France, improved considerably, and world consumption of all growths of cotton reached some 27,000,000 bales (500 lb. gross) compared with 25,500,000 bales in the previous season, the increase of 1,500,000 bales being accounted for almost entirely by American cotton.

164. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1936-37. (Pubd. annually in October by Thos. Skinner and Co., London, Manchester, Bradford, Montreal and New York.) The fourteenth issue of this indispensable work of reference of the world's cotton industry. The customary revision of details in collaboration with the leading Textile Associations throughout the world, has been carried through, and valuable additions have been made to the information previously published; in particular, the editorial relating to foreign companies has been considerably augmented. The Hosiery and Knit Goods Manufacturers Section has been completely revised and materially extended, and now contains a geographical index of hosiery and knit goods manufacturers; lists of cotton, silk, rayon, woollen and worsted hosiery yarn spinners and doublers; goods manufactured, and information concerning hosiery machine and accessory manufacturers. The thumb-holes for ease of preference are labelled: Contents; Index, Exporters, Merchants, Spinners, Manufacturers, Doublers, Directors (British), Dyers, Finishers, Fabrics, Silk and Rayon, Hosiery and Knit Goods, Mill Supplies. All headings, indices and explanatory notes are, as usual, printed in English, French, German, Italian, Spanish and Portuguese. No one connected in any way with the cotton industry can afford to be without this invaluable directory. The price by post, inland and abroad, is £1; Canada and United States, $7 (post and duty free).

165. COTTON MARKETING. By T. G. Hesse. (*Rhod. Agr. J.*, xxxiii., **8**, 1936, p. 565.) The following factors concerned with cotton marketing are briefly explained for the benefit of newcomers to the cotton industry: Futures, Hedging, Spot Transactions, Basis, Valuation.

ADDENDUM.

166. THE SOUTH AND EAST AFRICA YEAR BOOK AND GUIDE FOR 1937. (Edited for the Union Catsle Mail Steamship Co., Ltd., by G. Gordon Brown.) The 43rd edition of this invaluable work has recently been issued. Much useful information is given about the voyage out to South Africa, cost of living, hotel tariffs, motoring and aviation, native races and languages, sights and scenery, etc. An interesting account of the history of South Africa is included, and climate and topography are equally well treated. The individual states are described in detail, followed by sections dealing with labour, co-operation, irrigation, farming, mining, etc. For the benefit of the immigrant, practical information is included regarding the acquisition of land, land laws, agriculture generally, and the pastoral industry. For the benefit of the business man the present edition contains details of postal and telegraphic regulations, Ottawa Preferences, licences and stamps, income tax regulations, local weights and measures, currencies, etc. The gold industry, with the remarkable developments now taking place, is dealt with at considerable length. The first part of the book concludes with descriptions of thirty-six different routes of travel. The second half deals in a similar manner with East Africa. Finally, an excellent series of maps is included; many of these have been specially drawn for this book and are not procurable elsewhere. The index, covering 40 pages, includes over 2,600 place names, and practically constitutes a gazetteer. The price of the work is 2s. 6d. (3s. post free in the United Kingdom; 3s. 3d. elsewhere), and it is indispensable to anyone with interests in South or East Africa.

ERRATA

THE EARLY DEVELOPMENT OF THE COTTON FIBRE. By F. M. L. Sheffield. Vol. XIII., p. 281, line 21, for "cytochrome" in both cases read "pigment"; line 26, for "cytochrome is formed" read "pigment appears"; p. 282, line 5, for "cytochrome" read "pigment"; p. 284, line 29, for "cytochrome" read "pigment."

THE EFFECT OF LEAF CURL DISEASE ON THE YIELD OF THE COTTON PLANT. By F. W. Andrews. Vol. XIII., p. 290, Table IV., second line, for "60·3" read "30·3."

PERSONAL NOTES

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing the following officers are on leave in this country from cotton-growing countries:

Gold Coast	Mr. E. M. Cook.
„	Mr. R. J. T. Hooks.
„	Mr. G. R. Spurrell.
„	Mr. J. Wright.
Kenya	Mr. N. Humphrey.
Nigeria	Mr. M. W. Gibbon.
Tanganyika Territory	Mr. R. B. Allnutt.
„ „	Mr. J. V. R. Brown.
„ „	Mr. J. R. Curry.
„ „	Mr. N. R. Ruggles Couchman.
„ „	Mr. H. B. Stent.
„ „	Mr. F. W. Thomas.
„ „	Mr. D. Thornton.
„ „	Mr. A. J. Wakefield.
Uganda	Mr. A. J. Kerr.

The following officer of the Corporation's staff abroad is on leave in this country:

Nyasaland	Mr. S. T. Hoyle.

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher

THE
EMPIRE COTTON GROWING
REVIEW

VOL. XIV. APRIL, 1937. No. 2.

THE IMPERIAL AGRICULTURAL BUREAUX

BY

SIR DAVID CHADWICK, C.S.I., C.I.E.,
Secretary to the Executive Council.

"OF making many books there is no end." That lament expresses inadequately the scientist's feeling of despair when he thinks of the number of articles published throughout the world bearing on his own subject. The object of the bureaux system is to replace his despair by confidence, to substitute the sureness which comes from knowledge for the uncertainty which accompanies isolation, to save the time and enhance the efficiency of those who use the bureaux services. A high aim; not an unworthy one.

The general term "Imperial Bureaux" covers a group of agencies. Each deals with a specific subject or science. Each is located at a specially suitable research institute. Each is very similarly organized with very similar objectives, but each is developing to meet the chief demands of its clients. Yet all work in conjunction and all are under one general control, the Executive Council of the Imperial Agricultural Bureaux. This Council is composed of the nominees of the governments of the Empire who in mutually agreed proportions provide the funds for the work of the institutes and bureaux controlled by the Council. The organization is thus trebly co-operative. Each agency seeks to promote knowledge and co-operation among the scientists in the Empire engaged on its subject. The several agencies work in conjunction, not in competition. Taken as a whole they are a constitutional experiment in joint imperial administration.

Clearly, where a group of countries—like the British Commonwealth of Nations—join together in providing a continuing and common service, steps must be taken to ensure not only that financial and administrative control is exercised by their own representatives, acting as a Council—in this case the Executive Council—but that the activities, finance and work, both of the agencies and of the Council, are subjected to periodical review at Conferences charged with that task, and consisting of representatives specially sent from the contributing countries for that purpose. Without such periodical reviews governments could not be expected to provide year by year the funds required, nor could the development of the work be kept on the lines required by the numerous and scattered research institutes and agricultural scientists in the Empire. Such a review was made at the British Commonwealth Scientific Conference held in London in October last (1936). The report of that Conference deals chiefly with the work of the Council and its subordinate agencies, and with recommendations to governments for their development during the five years April 1, 1937 to March 31, 1942. It is recommended that in 1941 another review be made, but, if that prove impossible, the recommendations now made continue pending such review.

The agencies in the group and under the control of the Executive Council are:

The Imperial Institute of Entomology, situated at the Natural History Museum, South Kensington, with its offshoot the Laboratory for the Biological Control of Insect Pests located at Farnham Royal, Bucks.

The Imperial Mycological Institute located at Ferry Lane, Kew, Surrey.

The Imperial Bureau of Soil Science located at Rothamsted, Harpenden, Herts.

The Imperial Bureau of Animal Health at the Veterinary Laboratory, Weybridge, Surrey.

The Imperial Bureau of Animal Nutrition at the Rowett Research Institute, Aberdeen.

The Imperial Bureau of Animal Genetics at the Institute of Animal Genetics, Edinburgh University.

The Imperial Bureau of Plant Genetics (for Plants other than Herbage) at the School of Agriculture, Cambridge.

The Imperial Bureau of Plant Genetics (Herbage) at the Welsh Plant Breeding Station, Aberystwyth.

The Imperial Bureau of Horticulture and Plantation Crops located at the East Malling Research Station, East Malling, Kent.

The Imperial Bureau of Agricultural Parasitology (Helminthology) located at the Institute of Agricultural Parasitology, Winches Farm, St. Albans.

The Conference of October last recommended the addition of two more bureaux, one for Dairy Science and one for Forestry. If governments approve of these recommendations, twelve of the most important branches of agricultural, veterinary and forestry research will be provided with their own specialized intelligence services. These twelve branches do not cover the whole range of research in agriculture, veterinary and forestry, but go a long way towards it. The institutes and bureaux do not follow the divisions of science adopted in the schools, *e.g.* chemistry, geology, physiology and botany, but the divisions most common in applied research as conducted in research institutes and by agricultural, veterinary and forestry departments, *e.g.* soil science, applied entomology, plant and animal genetics, fruit. In organizing the bureaux attention has been primarily paid to the needs of research workers in agriculture, veterinary and forestry, yet they equally serve other scientists; the work on entomology, nutrition and helminthology, for instance, directly assists many engaged in medical research. University lecturers have found the abstracting journals of the greatest use in keeping their lecture notes up to date.

The activities of the institutes and bureaux vary somewhat, but the chief and common purpose of them all is the collecting, indexing, abstracting of all information in the world as it becomes available in its own branch, and its distribution to the research workers in the Empire interested therein. For this purpose each institute or bureau publishes an abstracting journal which is placed on sale. In all, four monthly journals, eight quarterly, and two annuals are issued, and the Council also helps the *Journal of Dairy Research*, which appears three times a year. This last contains some original articles. Of the other fourteen, ten are abstracting journals and four of the nature of classified bibliographies and lists. Also, from time to time the bureaux issue special monographs. These are either reviews with bibliographies attached on the state of knowledge of some special subject at the time of issue, or descriptions of technique. In the years from 1930 to 1936 over 110 of these special publications have been issued, covering subjects such as soil erosion, vernalization, the arrangement of field experiments and the statistical interpretation of results, the technique of artificial insemination, vegetative propagation of tropical and sub-tropical fruits.

Each institute or bureau must take special pains to maintain contact with research institutes and workers everywhere in its own subject, and is organized to obtain and search all journals. But it is not a mere library service which is offered. The staff of each institute and bureau must necessarily be highly trained linguistically, but the officers at the head are in every case specialists in their own branch of science. The reason for locating the institutes and bureaux at well-known research institutes is to ensure that the officers of the bureau are in the full current of their subject and meet and see specialists from other countries. Necessarily the articles abstracted are fewer than those indexed, but the close association of the bureau officers with active research workers everywhere helps such selection as is needed. In the larger subjects the aid of specialists outside the bureau is enlisted in abstracting. In every case the work is supremely up to date and the object is to keep it " live."

Since the War older research institutes have expanded and new ones have been founded in every country in the world. Agricultural, veterinary and forestry departments have everywhere been increased, and more specialists have been appointed. It is no exaggeration, but a literal truth, to say that a new specialist research post in any of these departments in any country—an entomologist in India, a veterinarian in Russia, a plant breeder in Mauritius or Canada, a soil scientist in the Philippines or the West Indies, a helminthologist in Germany or South Africa, it matters not who or where—increases ultimately the number of scientific articles published. Even if he be engaged mostly on routine it is probable that some results he may obtain will be published in some administration report and will possess more than local significance. Concurrently with this general expansion in activity, nationalist feeling in the last seventeen years has caused scientific papers to be published only in the national language, often even without summaries in English, French and German. Without the aid of a clearing centre a research worker cannot obtain all the information bearing on his subject, and if he could, cannot read it all.

The institutes and bureaux do not collect testimonials, but remarks in letters reaching them—often from those renewing subscriptions—illustrate these points. Thus, some taken at random:

(*a*) From the United States:

" Considering the chaotic way in which we publish in the different countries and the difficulty in finding what is published, I believe that yours is the greatest single contribution being made to . . . science."

(*b*) From a Dominion Council of Research:

" Through this bureau a complete search of all literature relating to . . . has been made, and summarized reports of the work in all countries of the world are now in the hands of those engaged on this class of investigation in . . .

It is when problems of this kind arise that the very real value of the research co-operation, established by the Agricultural Bureaux system, is appreciated."

(*c*) From another Dominion:

" Our only regret is that the Imperial Agricultural Bureaux were not instituted many more years ago."

(*d*) From England:

" A splendid illustration of the practical utility of your bureau to those of us who are doing research."

(*e*) From a Colony:

" Abstract. . . . This appears to be a paper of vital interest to me—as a matter of fact it almost duplicates an experiment of my own which is not quite concluded, and the fact that I had missed it for four years is an indication of the value of your service—I wonder if you could add to your kindness by procuring me a full copy of the original."

(*f*) From one worker in one foreign country to a fellow worker in another foreign country:

" While neither your country nor mine is in any way officially connected with the British Empire, from my own very happy and entirely personal and informal connexion with the Imperial Bureau of . . . I would strongly urge that that bureau be supplied with all copies of all circulars and progress reports of your committee or of its members. . . . Doubtless you know all this and more already and realize that there is no equally effective clearing-house for information on the progress of . . . science."

And so, many, many others. These extracts are not quoted to praise the bureaux but to substantiate the point that the research workers feel a real need for the service the bureaux strive to perform. For service is their watchword. They do no original research. Their function is to serve the research workers in the countries of the British Commonwealth of Nations.

Whilst the collection and dissemination of information is the chief of their services they have all repeatedly been asked for help in other directions: for translations, for introductions to other research workers, for aid in obtaining experimental material, for information on technique and methods, etc. In the two older Institutes of Entomology and Mycology—for in all this bureau work it has always to be remembered that it was the Imperial Institute of Entomology which was the successful pioneer—another form of service is a regular part of their duties. That is assistance in the identification of specimens. Each of the Institutes has a small highly trained staff of specialists for this work; each has also obtained the co-operation of specialists elsewhere. The Institute of Entomology sends out on the average every day of the year a list to some entomologist in some Empire country giving him the names of insects which he has sent to the Institute for identification. On the average the insects so named exceed 8,300 a year, of which over 400 prove each year to be new to science. These applications for help come from every Dominion and every colony, and it will be readily understood that it is with the more difficult identifications that the aid of the Institute is sought. At the Mycological Institute similar aid is given to the mycologists in the Empire. A room is also maintained in which mycologists from overseas can come and work at their own problems.

At the laboratory for the Biological Control of Insect Pests at Farnham House, an offshoot of the Imperial Institute of Entomology, another type of service has been provided. This Laboratory was started by the Empire Marketing Board, and since October 1933 has been maintained co-operatively by the governments of the British Commonwealth through the Executive Council. Biological methods of control of insect pests are frequently the only ones practicable. Their use is passing from the spectacular beloved of the general newspapers to what in truth it is, a specialized branch of applied entomology demanding its own specialized knowledge and its own technique. The laboratory at Farnham House exists to help entomologists in obtaining parasites which they may require and cannot get locally, and also to aid them with information on this specialized subject. In the year 1936-37 over 20 million parasites have been shipped overseas through Farnham House. These have been collected from many parts of England, from Czechoslovakia, from Hungary, from Scandinavia. Ten years ago, when the Laboratory was first started, it was thought to be doing quite well when its shipments in a year exceeded 100,000. In the current financial year a consignment has been despatched to some overseas Empire country on the average every other day. In the course of all its work much information of value about biological control has been collected, and one of the problems is to make that knowledge readily available.

The keynote of all this work, whether in the institutes or in the bureaux, is service to the research worker and to the scientist. It is no part of their functions to advise the farmer or the landowner. That is the duty of the national departments. When such requests are received, as they are from time to time, they are forwarded to the local department with or without additional information as the case may be. As against that inhibition, every effort, as far as the Executive Council is concerned, is made to encourage direct relationship and correspondence between the respective institutes and bureaux and research workers engaged in the corresponding branches of science. It is one matter to collect and print the information; it is another to see that it reaches the hands of those who most need it and can use it. For this reason the Executive Council encourages direct contacts, since there have been too many instances in the past in which information has by some mischance been stopped on the way. This direct contact is always subject to the condition that if any administrative or personal points threaten to arise, the matter be reported to the " Official Correspondent " in the country—*i.e.*, to an officer in that branch of science who has been appointed by his government to act as the local " friend of the bureau." The Conference of last October approved of this general policy and passed recommendations designed to make the services of the institutes and bureaux better known and more used in the various countries. They were definitely of the opinion that the services which are now available are not realized to the full in many countries of the Commonwealth.

The increase in the numbers of research institutes and the expansion of agricultural departments has been given as reason for the increasing need for services such as these institutes and bureaux render. Some indication of the growth of this scientific literature is shown by the increase in the number of articles abstracted. Thus in the last fifteen years the number of articles abstracted in the two journals of the Institute of Entomology has increased by over 1,000 a year, in the last ten years those in the journal of the Mycological Institute by over 500, whilst those contained each year in journals of the bureaux now exceed 15,000, besides another 13,000 entered only in bibliographies.

The distribution of the journals is as follows:

	To Countries in the British Commonwealth of Nations.	*To the Anglo-Egyptian Sudan.*	*To Foreign Countries.*
Free	2,430	32	18
In exchange and to contributors ..	207	—	728
To subscribers	1,912	9	2,102
	4,549	41	2,848

Quite apart from the constitutional interest which arises from the fact that for eight years now the British Commonwealth of Nations has shown that it can organize and maintain under joint control a common service to meet a common need, and can adjust the work of that service to meet changing conditions, and can, as the Conference recommended, contemplate its continuance—quite apart from that constitutional side, the co-operative nature of the organization has direct bearing on the work. It is not a case of one country maintaining a service and graciously giving the benefits thereof to its friends. The countries of the Commonwealth have equal voices in its day to day control. Each can justly regard all the institutes and bureaux as part of " its own show." So certainly do the officers employed in the bureaux. They are not there to instruct or direct; they are there to help as colleagues in the same endeavour.

Then there is the question of expense. A service of this nature is needed, and will be increasingly needed as time goes on, if scientists are to be in a position to give of their best. Quick, up-to-date knowledge of what is going on in his own branch of science is as much part of a scientist's equipment as a test tube or a microscope. If each country sets out to provide its own service of abstracting, how many times more expensive would it be than the present system of sharing costs and control? But, it may be said, why not organize it internationally? If that were done, would control and administration be simplified or rendered more complicated? Would research workers in the Empire have the preferential rights to attention they now possess? Would it be so much cheaper?—the journals would have to be printed in several languages.

The formal bibliographies interest chiefly the libraries at research institutes. But the rest, the abstract journals and special reviews, directly affect the research worker. Scientists have in effect said: " It is not sufficient that the journal should be in the library. It should be beside the worker on his laboratory bench, within reach of the lecturer revising his notes, in the possession of the young scientist starting on his life's work."

The whole organization is not something distinct and remote from the scientific and research institutes and from the scientific departments in the countries of the British Commonwealth of Nations; it is part of " their own show " and exists for their advantage.

Received February, 1937.

THE FIRST TEN YEARS OF THE AMANI RESEARCH STATION

BY

W. NOWELL, C.M.G., C.B.E.,
Late Director, Amani Research Station, Tanganyika Territory.

WHEN the decision was taken, somewhere around 1925-26, to restore the Research Station at Amani, the site of the Biological and Agricultural Institute of German East Africa, official circles showed an awakened interest in the subject of agricultural research in the Empire, and did much constructive thinking in connection with its organization. Active influences were at work in the Colonial Office and in the Empire Marketing Board, the latter a new force unfettered by the older departmental inhibitions, using its freedom to support many projects generally admitted to be desirable but previously impossible to develop because no channel existed through which the necessary funds could flow. This general stirring of the waters culminated in the Imperial Agricultural Research Conference of 1927, a high tide which has left deep permanent marks, although its ebb in the succeeding years of the great depression carried back much promising construction.

Among the wreckage was the project to establish a chain of Stations at appropriate points around the Empire for the purpose of pursuing fundamental research in agricultural science. Two of the proposed links were already in existence, the Imperial College of Tropical Agriculture in Trinidad and the newly established East African Research Station at Amani; the rest for the reason indicated failed to develop. The later closing down of their prospective means of support, the Empire Marketing Board, seems to have removed any lingering hope that trade recovery might lead to a revival of the project.

Ten years' experience of the working of the Amani Station is now available as evidence of the soundness of the plan, and the purpose of this article is to review its history and to suggest some conclusions in that connexion.

Given a commission to carry out "fundamental research," the first problem to be faced was the meaning of that expression, a question on which perhaps no two men of science could be found wholly to agree. There is a popular tendency to substitute the phrase "long-range research" as conveying a clearer explanation of the idea, but it is preferable to use this as an extension rather than as an alternative. Fundamental research may be short or long; long-range research is not necessarily fundamental, but as a matter of convenience is best undertaken by an institution not concerned with immediate practical results. Though the nature of fundamental research cannot be defined, it can perhaps be explained in this connexion as the study of the principles underlying and relating the applications of science to practice.

The field provided by the six African dependencies contributing to the maintenance of the Amani Station is in every sense extremely wide. In extent it stretches from the Zambesi to the head waters of the Nile, and from Zanzibar to the great central lakes. Agricultural conditions range from rain forest to semi-desert, from tropical coast plantations to plateau farms at elevations of seven thousand feet or more, through a series of crops from cloves and coconuts, cotton and sisal, to coffee, tea, maize and wheat. Under such circumstances no site can be more than an inadequate compromise, no programme more than a small selection of the possibilities offered.

The site of the Amani Station was originally chosen as a centre for what was expected to be a great coffee plantation area in the forests of the Usambara Mountains, at elevations round three to four thousand feet. The failure of these expectations has left it for the present isolated from any immediate surrounding of agricultural industry. There are good prospects that the result of its own investigations with suitable crops for the area will remove this disability, if such it be considered—a question upon which opposite opinions are tenable. The proximity of the Usambara Mountains to the sea gives the site the essential advantage—not shared by any that could be selected on the main highland area—of the combination of healthy working conditions for Europeans, with ready accessibility to the coastal cultivations and to the main lines of communication by sea.

Determining factors in the decision to continue the occupation of Amani for the wider purposes of an East African research station were the desirability, in which political considerations had a part, of continuing the honourable traditions of the German Station, and from a material point of view, the existence of a developed site, with roads, plantations, and valuable permanent buildings requiring only some degree of repair to be ready for occupation. Heavy capital costs and much delay were thereby avoided. Apart from the valuable nucleus of a scientific library, and a large collection of herbarium specimens, there was little that was serviceable in the remaining equipment. The scope of the field side of the station, which has a range of elevation from 1,500 to 3,700 feet, was enlarged by the addition of a neighbouring estate with nearly a thousand acres of semi-derelict coffee plantations.

A draft programme of research, prepared by the Director after a tour of the countries concerned, was approved by an *ad hoc* committee in London, and later, with little modification, by a conference on the spot in which the local Directors of Agriculture took part, with the Agricultural Adviser to the Colonial Office presiding. The funds available, which were then officially regarded as adequate only for a beginning to be made, permitted of the appointment of six research officers with two European laboratory assistants, a systematic botanist, a superintendent of plantations, and the necessary secretarial, clerical, and maintenance staff. This skeleton establishment continues to the present day. The natural expansion which was expected to follow as the Station grappled with its problems has been prevented by the general financial crisis. Considering the severity of this in relation to the sources of support, the fact of even bare survival is no small recognition of the value of the services rendered.

The six sections into which the research programme is divided are Soil Science, Plant Physiology, Plant Genetics, Plant Pathology, Entomology and Plant Biochemistry. An attempt is thus made to carry on work in all the main divisions of agricultural science. Had the restrictions imposed by circumstances been foreseen it would probably have been better to concentrate the available resources into narrower channels. The writer's choice, in this event, would have been to omit plant pathology and entomology, not because these subjects are less in need of fundamental investigation, but because provision for them is more readily made in the organization of agricultural departments, while in comparison with the other subjects they are less constructive in their application.

Of all the sections concerned least question is likely to arise regarding the desirability of the fullest possible provision for the development of soil science. The dominant position which this subject has held in the prototype of agricultural research stations—Rothamsted—will be recalled. It has been the object of the soil investigations based on Amani to work towards a natural history of African soils. As far as the hopelessly inadequate man power has permitted, much has been done to examine and sample soil profiles and to relate them into groups, supplementing observation by laboratory analysis. The main difficulty encountered has been to balance the conflicting claims of wider travel for the purpose of extending knowledge of soil types and their distribution, and of detailed examination of those already collected. Much assistance has been rendered by auxiliary collectors, especially district agricultural officers, and members of the forestry and tsetse control departments. In addition to its direct investigations the soil section has functioned as a clearing-house for the exchange of information and the co-ordination of methods with the soil chemists working in the departments of agriculture. Two special conferences have been held to further these objects, and the outcome has been the issue of a soil map of Uganda, Kenya, Tanganyika and Zanzibar, in which the information available from all sources is summarized, and not least in importance, the vast gaps in our knowledge of distribution displayed. It is only now, when the broad lines of agricultural development have been laid down by a long and expensive process of trial and error, that studies have been initiated which will make possible, at some future date, the type of land utilization survey on which settlement should ideally be based. Failures are apt to be explained instead of foreseen, as, for example, the thirty years of effort to grow Arabian coffee in the Usambaras, dating back to German times.

In an agricultural country, knowledge of the soil and of its capabilities, and of the measures necessary for its preservation, should be the basis of administration. Some realization of this in one aspect, that of soil erosion, has now entered the public mind, but there is little evidence as yet in East Africa that it has affected general administrative policy.

The magnitude of the work that faces the staff of one officer and one laboratory assistant is well illustrated in the latest progress reports, in which are listed seven important groups of soils or well-marked areas encountered in one journey in Tanganyika, of which next to nothing is known, and to this list is appended a neglected problem which affects the whole of Africa, namely, the relation of termites to soil formation and fertility. The termites await their Darwin.

The work at Amani in direct relation to crops has been mainly concentrated on coffee and sisal, which were assigned to the Station in the original scheme of distribution. They have received the undivided attentions of the geneticist and the physiologist, supplemented, as to coffee, by some of the services of the biochemist.

East African sisal is the product of *Agave sisalana,* accepted botanically as a species but in all probability a clone of hybrid origin. Its only departure from uniformity, apart from the effects of environmental influences, is the tendency of a proportion of the bulbils formed on the inflorescence to develop spiny margins to their leaves. It is reproduced for commercial purposes entirely by vegetative propagation, either from bulbils or from lateral suckers. The leaves are cut in succession as they mature, and the fibre, which consists of strands running lengthwise in the body of the leaf, is extracted in a machine which scrapes away the epidermis and the fleshy tissues.

The plant is a highly resistant xerophyte, and its cultivation under anything approaching reasonable conditions gives little trouble. It can hold its own in competition with weeds and is little troubled by insects or disease. So far as the industry has existed to supply fibre for binder twine, it has required and received little scientific attention. Not only was the absence of information regarding an important plant industry felt to be a reproach, but the development of more diversified uses of the fibre, and the desire to find further applications for it, demanded a study of its properties and potentialities.

At the time when work at Amani began, when samples were sent to London the accepted method of scientific assay was chemical analysis, the results of which must have been singularly uninstructive to the spinner. The first necessity was to determine the distribution of fibres in the leaf. They occur in all lengths up to the length of the leaf itself, and also vary greatly in diameter; they are, moreover, of compound structure, and are capable, especially the coarser ribbon-shaped types, of longitudinal subdivision under mechanical treatment. In these circumstances sampling presented serious difficulties, which had to be met by mechanical mixing checked by statistical analysis. In determining such properties as breaking strain very large numbers of measurements are necessary, and it is fortunate that the African youth is happy to sit and repeat a simple operation for months and years.

A large amount of information has been accumulated, and is now in course of publication, concerning the distribution, length, fineness, and strength of sisal fibre and the correlation of these properties. In addition, the relationship between fibre length and leaf length has been made clear. The methods of examination have been extended to related species, and are now being applied to one of the main purposes for which they were designed, the evaluation of the new varieties produced by the plant-breeder.

Genetic studies began with the seedling offspring of *A. sisalana*, which proved to be incredibly diverse. No form has yet emerged, however, with promise of agricultural or commercial superiority to the parent, and attention is turning to the progeny of *A. amaniensis*, itself a very promising type derived apparently from a chance introduction, and its hybrids with *A. sisalana*. A wide range of material representative of the genus has been brought together, and cytological studies are throwing light on its constitution and affinities.

The result of this work is that there will be available in the future a choice of planting material to give fibre of differing characters, and this should help considerably the object which is the growers' chief present concern, the extension of its uses.

The cultivation of coffee has a long tradition behind it, with methods locally adapted to the widely distributed countries in which it is established. Not only do these methods differ greatly, but there are often, especially in newer areas, wide differences of opinion and practice and radical changes of treatment in the same district, as, for example, in the provision of shade. It has been the concern of the Amani workers to study the constitution of the plant, and to reveal the physiological basis of its reactions to the conditions imposed upon it. An early and most instructive investigation demonstrated strongly marked differences in the root systems developed in various districts and revealed the unsoundness of the tradition that coffee needs, or prefers, an acid soil. It is, in fact, suggested that antipathy to acid conditions explains such failures as that of the great German effort to establish the industry in Usambara.

Study of the condition, prevalent in the principal coffee area of Tanganyika, and often seen elsewhere, in which the bearing of a crop is succeeded by dieback of the fertile branches and of the finer roots, has shown it to be associated with carbohydrate depletion. This has led to a comprehensive examination of the light and water relations of the plant, including the movements of the stomata and their relation to photosynthesis. The knowledge gained supplies the foundation required for the study of all the questions in which assimilation is concerned.

The combined results of research and agronomic experimentation carried out by the Amani Station and by the scientific staffs of the Departments of Agriculture are contributing at an increasing rate to the agricultural soundness of the coffee industry. There is one problem, however, on the commercial side, in which the methods of science have been defeated, namely, the attempt to find a measure of quality as understood on the market. A similar difficulty has not been unknown to the cotton grower. So long as this measure is lacking the main factor in the wide variation in the prices realized remains outside any attempt at control.

A coffee estate in Kenya was used by the Entomologist for an initial effort in a type of investigation which could profitably be extended to all important crops growing under representative conditions. It involved the detailed recording, over a period of significant length, of all the measurable factors which make up the climate actually in and around the plants, and the comparison of these measurements for correlation purposes with others made nearby under standard conditions. The idea behind this study of eco-climates is that it reveals the intimate conditions in which the insect fauna (and no less the fungus flora) have their existence. Striking differences in infestations, due to local conditions, are frequently encountered, and analysis of the factors involved, as for example humidity, should provide guidance as to the direction in which the conditions may be modified to render them less congenial to the pests concerned.

The work of the section of Plant Pathology has been concentrated on the virus diseases of tropical plants and especially, so far, on an intensive study of the transmission of a virus disease of maize by its insect vector. Important contributions have been made to knowledge of a subject of great scientific importance. There is no lack of subjects for further investigation, since serious diseases of this class exist on such staple African crops as sugar-cane, cotton, cassava, and ground nuts. An incidental result obtained has been the recognition and complete control of a severe disease of tea which was thought to be possibly a virus infestation but was found to be due to sulphur deficiency.

Biochemical research—apart from its contribution to the study of the physiology of the coffee plant and a demonstration of the unimportance, from the point of view of any effect on quality, of the process of coffee fermentation—has been largely occupied with the vegetable insecticides derived from plants used by natives as fish-poisons. Early work was done on *Tephrosia vogelii*, which is widely used for this purpose in Africa, and in testing numerous other plants less well known. Later the introduced *Derris elliptica* was the subject of test, and most recently another indigenous fish-poison, the bark of *Mundulea suberosa*, a widely distributed small tree. These investigations are parallel with work at Washington, Rothamsted, and as regards Derris, in Malaya, as well as in many commercial laboratories, the subject being one of growing commercial importance. The chief difficulty is to find chemical or biological methods capable of use in determining relative toxicity.

The circumstance that the officer appointed as secretary to the Station is an ardent student of ornithology has led to some official recognition of this subject, and has considerably increased the scientific output. Series of papers are being issued dealing with distribution and the relation of birds to their environment, in which much new ground is broken, especially in regard to tropical conditions. A commencement has been made in the systematic study of the food of selected groups of African birds by the examination of stomach contents, a matter of considerable agricultural interest on which little information exists.

What may be called the central services of the Station to the East African area are of no small importance. The library receives a wide range of publications and affords to scientific workers in the area access to literature otherwise available only during periods of leave. The gaps left by the years between 1914 and 1926 in the series of periodicals were made good by a grant from the Carnegie Trustees, and in 1934 the same body having "been much impressed by the importance not only to the British Colonies and Territories of East Africa but to Tropical Africa as a whole" of the Research Station at Amani, provided for the Library an endowment of £10,000.

A further service which is much used and greatly appreciated by officers in agricultural, medical, veterinary and other scientific departments is that of plant identification by the botanist in charge of the Herbarium. This saves a great deal of the delay involved in reference to botanical institutions in Europe.

As the result of an agreement between the departments of agriculture, approved by the Secretary of State, the Station maintains a central Plant Quarantine Station for East Africa, through which are passed all introductions of important crop plants and related species. The cost of the necessary equipment was met from the Colonial Development Fund.

In addition to its main research activities, and without encroaching upon them, the Station has been able to carry on, by means of its plantations and nurseries, its inheritance from the German period of an interest in plant products which may form the basis of new agricultural industries. Cinchona has been successfully cultivated at Amani since 1902, and there is now some prospect of its cultivation on a considerable commercial scale. Of more recent introductions Derris and Aleurites have good prospects. Chemical analysis is essential for the control of trials of the two first named and some botanical problems need study in the case of the third. These requirements the Station is able to meet.

In the light of this review of the history of the first ten years of the existence of the East African Station, consideration can be given to the question how far the nature of its achievements and the position occupied in relation to agricultural organization justify the original conception. The conclusions to be drawn will depend mainly on the view taken of the functions proper to be developed by the regional departments of agriculture. Special stations for research not being in existence, these have perforce combined such provisions for research as local governments would agree to finance, with their substantive functions of providing advice to agriculturists, and guidance to the administration on matters concerning agricultural industry. Most commonly the scientific officer is responsible both for investigation and for the application of its results in the form of advice, a situation precluding the successful undertaking of the more serious forms of research, which demand continuity and freedom from distraction. Agricultural departments cannot afford to dispense with a scientific staff, but a detached institution, directly organized for its purpose, free from any industrial connexion and sheltered from popular or administrative interference, has great and obvious advantages over any expansion of this staff with the object of providing for the systematic research required.

Received February, 1937.

AMERICAN COTTON RESTRICTION AND ITS EFFECT ON OUTSIDE GROWTHS

BY

JOHN A. TODD, M.A., B.L.

In a series of articles published in this Review on the dates given below* the writer recounted the history of the various measures taken by the American Government to reduce their crop and to get rid of the huge surplus which had accumulated at the end of season 1931-32, while at the same time raising the price of cotton by inflation and by enabling the growers through loans to hold their cotton off the world's markets. The last of these articles brought the history down to February, 1936, when, on the finding of the Supreme Court declaring the Agricultural Adjustment Act unconstitutional, the Government replaced that scheme for 1936 by the amended Soil Conservation Act. Since then there has been no new legislative development, and the policy of the Government seems to have been rather to restrict their intervention to a minimum and to get out of their enormous loan holdings. It seems desirable, therefore, to wind up the whole history (for the time being at least) by describing how things worked out in 1936 and how far the Government have succeeded in getting rid of their holdings. At the same time it is now necessary to consider the effect of the whole business of American Government action on the world's cotton supplies and consumption as a whole, and on cotton prices.

As to the effect of the Soil Conservation Act on the 1936 American crop the position is perhaps best seen by placing the 1936 figures in relation to those of the preceding seasons, as is done in the table on page 111 which carries the history back to the bumper crop of 1931. It will be seen that there was some relaxation of the restriction of acreage in 1936, and that with a fair average yield the crop was at least heading back towards something like normal.

The next point is the development of the Government's loan policy and the disposal of their holdings, which were the legacy of that policy in the years up to 1934. At the end of season 1934-35 their total holdings amounted to about 6,000,000 bales in spite of every effort to get rid of them, including large grants for relief purposes. Owing to the greatly modified loan policy of 1935, very little was added to their holdings in that season, and in the spring of 1936, as the result of the new scheme described in the April, 1936, issue, they succeeded in disposing of a really substantial amount, bringing the total at the end of 1935-36 down to about 3,000,000 bales. No further loans were granted on the 1936 crop, and in the spring of 1937 another scheme on similar lines to that of a year earlier was launched, which is likely to result in the release of at least another million bales.

---

* "Finance, America and Cotton Prices," vol. xi., p. 1 (January, 1934). "American Cotton Legislation," vol. xii., p. 103 (April, 1935). "American Cotton Legislation," vol. xiii., p. 83 (April, 1936).

AMERICAN CROP.

Season.	*Acreage** (000's.)		*Crop: 500 Lb. Bales* (000's).	*Yield per Acre:* Lbs.*	*Season's Average Price†* (*Cents*).	*Carryover at End of Season* (000's).
	Planted.	*Harvested.*				
1931–32 ..	39,110	38,704	17,096	211·5	5·89	12,798
1932–33 ..	36,494	35,891	13,002	173·5	7·05	11,550
1933–34 ..	40,248	29,383‡	13,047	212·7	10·12	10,509
1934–35 ..	27,860	26,866	9,637	171·6	12·11	9,003
1935–36 ..	27,888	27,335	10,638	186·3	11·33	7,004
1936–37 ..	30,932	30,054	12,407	197·6	—	*6,500*

* Acreage figures revised 1936, affecting yield per acre.
† Average Spot Prices in ten designated spot markets.
‡ Less 10,396,000 acres "special abandonment."

The method of release was, briefly, that the growers were allowed to "repossess" the cotton pledged under the 12 cent loans at a price roughly 25 points below the average spot price in the ten "designated" spot markets throughout the Belt, the Government bearing any loss as well as the carrying charges. It was estimated that this meant altogether about 2 cents per pound to be met by the Government, which it will be remembered was just the amount of the bonus given to the growers on the 1935 crop to induce them to sell, rather than hold again by fresh borrowing. The result worked out at a price of about 11·25 cents in the spring of 1936, subsequently raised to 12·25 before the end of that season. In February, 1937, the minimum release price was 12·50 cents.

As to the prospects for the 1937 crop, the Government have announced that the Soil Conservation Act of last year will again be applied on similar lines, and it is expected that this will result in a moderate increase of acreage, say 10 to 15 per cent. But the Secretary of Agriculture recently announced that, if necessary, this would be followed up by commodity loans for the storage of farm products whenever the supply exceeds normal requirements, extra benefit payments to encourage acreage restriction if the loan programme fails to curtail acreage, and rigid crop control should the first three measures prove ineffective in reducing surpluses. It is believed, however, that in all this the Government have mainly in view the idea of the "ever-normal granary" for wheat, and whether it will be applied to other commodities like cotton will depend upon how the situation develops in each case.

This would seem to indicate a possible return to the full system of control under the Agricultural Adjustment Administration, and that must be taken in conjunction with President Roosevelt's message to Congress in February, 1937, in which he proposed the addition to the Supreme Court of other judges to supplement those who fail to retire after the age of 70. As most of these older judges were among the majority who voted against the New Deal legislation, the object of such appointments is fairly obvious.

Turning now to the effect of all this on the position of the world's cotton supply, the next table gives the history of the world's cotton crops, distinguishing between American and Outside Growths, back to 1919, along with the Federation statistics of world's consumption divided in the same way. The date 1919 is chosen in order to provide a comparison with a somewhat similar period of restriction of the American crop (due to the boll weevil) in 1921-23.

PRODUCTION AND CONSUMPTION—AMERICAN *v.* OUTSIDE GROWTHS

Season.	*Production (500 lb. Bales 000's).*			*Consumption (Running Bales 000's.)*			*Apparent Excess of Production.*	
	American, Excluding Linters.	*Outside Growths.*	*Total.*	*American.*	*Outside Growths.*	*Total.*	*American.*	*Outside Growths.*
1919–20	11,421	10,887	22,308	12,437	6,672	19,109	- 1,016	+4,215
1920–21	13,440	8,026	21,466	10,033	7,913	17,946	+3,407	+ 113
1921–22	7,954	8,233	16,187	12,728	8,381	21,109	- 4,774	- 148
1922–23	9,762	10,001	19,763	12,594	9,449	22,043	- 2,832	+ 552
1923–24	10,140	10,218	20,358	11,080	9,316	20,396	- 940	+ 902
1924–25	13,628	12,011	25,639	13,270	10,039	23,309	+ 358	+1,972
1925–26	16,104	12,585	28,689	13,736	10,950	24,686	+2,368	+1,635
1926–27	17,977	11,018	28,995	15,777	10,362	26,139	+2,200	+ 656
1927–28	12,956	11,745	24,701	15,407	10,134	25,541	- 2,451	+1,611
1928–29	14,478	13,069	27,547	15,066	10,806	25,872	+ 588	+2,263
1929–30	14,825	12,401	27,226	13,015	12,186	25,201	+ 1,810	+ 215
1930–31	13,932	12,756	26,688	10,901	11,580	22,481	+3,031	+1,176
1931–32	17,096	10,938	28,034	12,316	10,003	22,319	+4,780	+ 935
1932–33	13,002	11,431	24,433	14,171	10,182	24,353	- 1,169	+1,249
1933–34	13,047	14,383	27,430	13,534	11,577	25,111	- 487	+2,806
1934–35	9,637	14,934	24,571	11,354	14,447	25,801	- 1,717	+ 487
1935–36	10,638	16,541	27,179	12,735	14,659	27,394	- 2,097	+1,882
1936–37	12,407	19,573	31,980	12,750	16,500	29,250	- 343	+3,073

It will be seen that during the period 1920-25 the supply of Outside Growths increased by fully 50 per cent., but was quickly checked by the spectacular recovery of the American crop in 1924-26. Again in 1931 and 1932 the increase of Outside Growths was checked by low prices and especially by the cheapness of American cotton, due to the bumper crop of 1931. But since 1932, the increase of Outside Growths has been absolutely unprecedented, and there is no possible doubt that that has been mainly due to the small supplies and the artificially high price of American cotton.

It will be seen from the next table that the development of Outside Growths has been worldwide and steady. Every country or group included in the list shares in the increase, and it is particularly notable that in spite of the rapid recovery of the American crop since 1934 the percentage of Outside Growths to the total is still being maintained.

WORLD'S CROPS—SUMMARY (500 LB. BALES, EXCEPT INDIA).

	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.	*Per Cent. on* 1931.
U.S.A. (excluding linters)	17,096	13,002	13,047	9,637	10,638	12,407	72·6
India	4,007	4,656	5,108	4,858	5,728	5,959	148·7
China	1,733	2,195	2,652	3,033	2,415	3,766	217·3
Egypt	1,271	991	1,715	1,511	1,707	1,889	148·6
Russia	1,846	1,776	1,917	1,774	2,374	3,750	176·1
Brazil	575	438	1,014	1,359	1,718	1,800	313·0
Mexico	203	99	255	223	243	359	176·8
Turkey	89	28	134	171	241	277	270·8
Peru	228	237	278	336	351	345	151·3
British Empire ..	387	414	447	579	589	616	159·2
Korea, etc. ..	99	133	197	224	230	275	277·7
Argentine ..	165	146	191	295	367	475	287·9
Smaller crops ..	335	318	475	571	578	562	167·8
Total Outside Growths	10,938	11,431	14,383	14,934	16,541	19,573	178·9
Grand Total ..	28,034	24,433	27,430	24,571	27,179	31,980	114·1
Outside Growths per cent. of Total	39·0	46·8	52·4	60·8	60·9	61·2	—

It is satisfactory to note that the Empire crops apart from India* have fairly well kept pace with the increase of most of the other countries as shown by the last column (percentage 1936 on 1931), and in 1931 the Empire total had already made a very large increase on the pre-war total, which was only 76,000 bales in 1914.

The increased supplies of Outside Growths are very striking, but still more remarkable is the increase of consumption which has followed the growth of supplies during the last three seasons with a curious apparent lag of a year. It must be remembered that what has driven spinners, especially in Europe, to the use of Outside Growths has been not merely the relatively high price of American but the sheer impossibility of getting supplies of American, or of the kind of American that they wanted. The official quotations do not by any means represent the full extent of the appreciation of American prices, for in recent years the " basis "—*i.e.*, the differences which must be paid in order to get anything better than the lowest tenderable grades—has been very high. Now Lancashire uses mainly the better grades and staples of American cotton, which have been particularly scarce, especially in the recent drought years, and the worst feature of the position in Liverpool in recent years has been the virtual disappearance of these better cottons from the Liverpool stocks. British spinners have therefore been driven to use Brazilian, East African, Tanguis and Uppers in place of the best staple Americans. Again, Lancashire has been making great efforts to fulfil its promise under the Ottawa Agreement to use more Indian cotton, and with remarkable success. Here the increasing percentage of the Indian crop, which is of approximately American staple (see Table on p. 138), has been an important factor.

---

* As to India, see details in our usual statistical article on p. 134.

Again, in the case of Continental countries, the difficulty of acquiring American cotton has been largely a matter of finding the necessary exchange to pay for it. Germany, for example, is unable to pay for American cotton because of the decline of her exports and the greater necessity of importing raw materials for armaments. But she was able for a time to make barter arrangements with Brazil for her cotton, which replaced American in Germany to a very large extent.* Further, Germany has been forced to develop the home manufacture of substitutes for imported textiles to a greater extent than any other country.

On that point it is very satisfactory to note that in spite of the enormous relative increase of the world's production of artificial silk, especially staple fibre, the world's consumption of All Kinds of Cotton is increasing as fast as the total supply. What is happening is simply that while the world's consumption of American cotton has fallen very badly behind in recent years, due to the absence of the supply and the relatively high price, the consumption of Outside Growths has been going up by leaps and bounds, so that the world's consumption of All Kinds in 1935-36 was unquestionably a new record, and in 1936-37 that record will be exceeded again.

With regard to the statistics of consumption given in the table

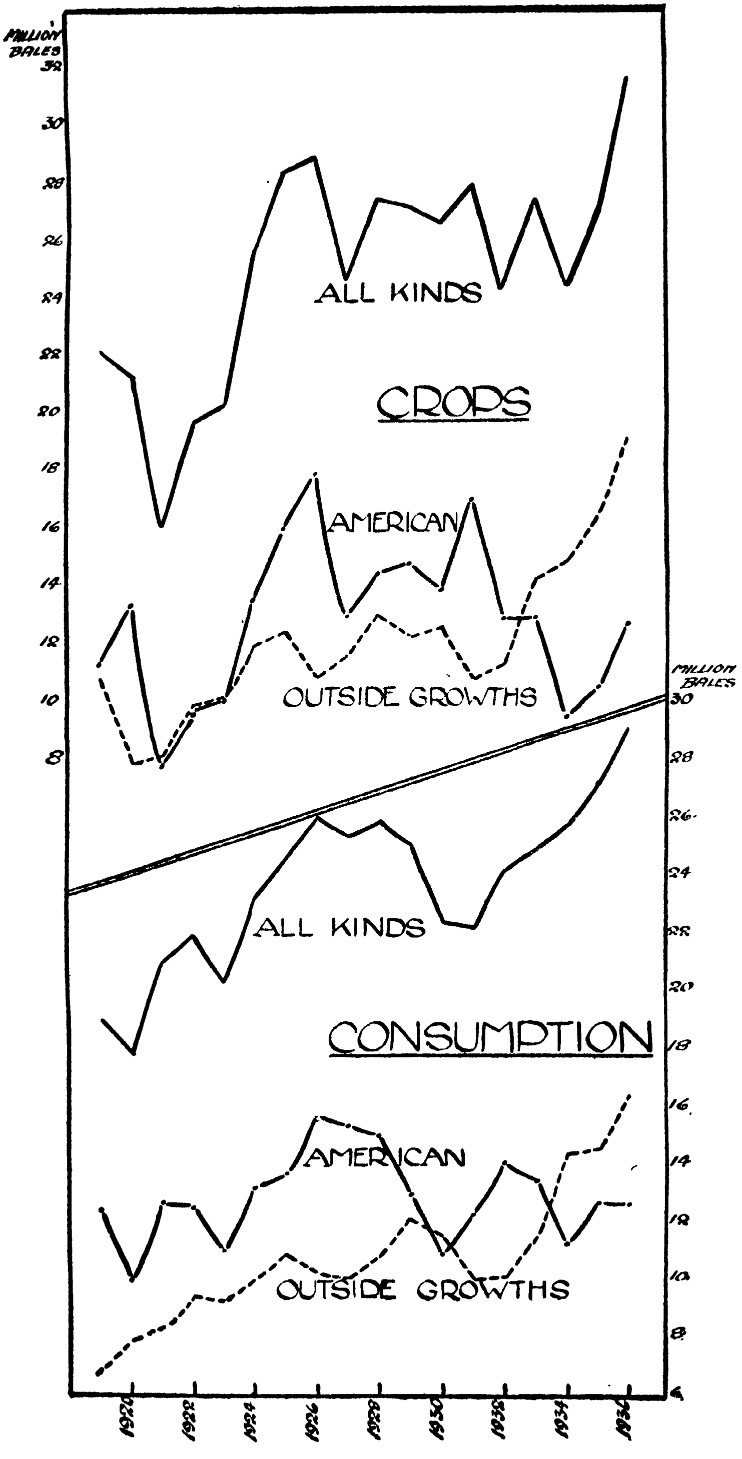
---

*** Germany is now trying to make similar arrangements with the U.S.A.**

on p. 112, however, there are three points to be kept in view. The first is the incomplete character of these statistics in recent years to which we have frequently referred in our statistical articles, and on that point it will be noted that the statistics in this table are those of the Federation, completed as best we can by our own estimates, while the figures given in our statistical article in this issue (see p. 136) are Garside's estimates, which show considerable discrepancies from our estimates, especially in 1935-36. Secondly, the Federation statistics of consumption are all in running bales, whereas our crop statistics are as nearly as possible in 500 lb. bales; but the running bale weight in Egypt is about 750 lb. while in the Empire countries it is 400 lb., and in many of the smaller countries it varies a great deal and probably averages less than 400 lb. The third point is that the Federation statistics are of mill consumption only and make no attempt to include the purely domestic consumption of the handloom industries, which in many countries, especially India, is very large. In China, too, it has always been understood that a very large part of the crop was used for domestic consumption, including the wadding of garments. The result is that we must add to the statistics of the world's consumption of Outside Growths an unknown quantity, perhaps as high as two million bales, for this purely domestic consumption, and this goes a long way to account for the heavy figures of apparent excess of production over consumption of Outside Growths in certain years shown in the table.

Finally, the whole position is shown graphically in the diagram on p. 116, which shows not only the world position of All Kinds both as regards production and consumption, but also the relative position of American and Outside Growths in both respects. Making every allowance for the difficulties of the statistics, the whole position is very clearly brought out by the diagram as follows: World's supplies and world's consumption of cotton of All Kinds have risen on the whole steadily throughout the post-war period and are now again reaching record figures. But this result is due to the fact that, as against the heavy reduction of the American crop and consumption since 1931, the supply and consumption of Outside Growths have increased to an extent never before known, and these conditions are likely to continue so long as the American Government persists in its policy of restriction. That policy has been a godsend to all the other countries that grow cotton, and not least to those of the British Empire.

Revised to 10th March, 1937.


MILLION BALES
32
30
28
26
24
22
20
18
16
14
12
10
8
ALL KINDS
CROPS
AMERICAN
OUTSIDE GROWTHS
MILLION BALES
30
28
26
24
22
20
18
16
14
12
10
8
6
ALL KINDS
CONSUMPTION
AMERICAN
OUTSIDE GROWTHS
1920
1922
1924
1926
1928
1930
1932
1934
1936

PROGRESS IN PHYSIOLOGY

BY

E. PHILLIS,

Cotton Research Station, Trinidad.

THIS article is an account (written in as non-technical language as possible) of some of the more interesting features of the investigations, completed and in progress, of the Physiology Department of the Cotton Research Station in Trinidad. These investigations cover only a few fields of enquiry, but similar problems are being studied in other institutions and, where positive results have been obtained, these have been included along with our own to make a more complete picture of progress in the various fields. Although Sea Island cotton is the only plant discussed, the fundamental principles should apply to all higher forms of plant life and should be of interest and practical significance to those in any way concerned with the growth and development of crop plants.

The raw materials required by the plant are oxygen and carbon dioxide which are absorbed from the air, and certain mineral elements and water, which are obtained from the soil. In addition the plant requires appropriate climatic conditions, and, particularly, adequate supplies of light. Light can be classed along with the essential raw materials since it is the source of the energy required by the plant.

The primary process in the plant, and the one on which most others would appear to be dependent, is that of photosynthesis, by which sugar is produced from carbon dioxide and water. The conversion is brought about through the agency of the green colouring matter of the leaf—chlorophyll—which in some unknown manner can utilize the energy of sunlight for this purpose. One of the chief uses of sugar is that it forms the fuel, which on combustion produces the energy required for the maintenance of the vital processes of the plant. The oxygen required for efficient combustion is obtained through minute openings in the plant surfaces, which also serve for the exit of the carbon dioxide produced during the combustion. In the leaf, where large quantities of carbon dioxide as well as oxygen are absorbed, the openings are considerably elaborated and are known as stomata.

The various elements absorbed by the plant fall into three classes. The first includes the elements which are essential for growth and which are taken up in considerable amounts, such as nitrogen, phosphorus, potash, calcium, magnesium and sulphur. The supplies of the latter three in the soil are usually, but not always, sufficient for good growth, while one or more of the first three are often short. Fertilizers and organic manures are widely used to maintain adequate amounts of these elements, particularly the first three, in the soil. The second group includes elements essential for good growth, but which are only required in small amounts, or even traces. This group includes iron, manganese, boron, aluminium and perhaps copper and zinc. The third group includes elements such as sodium and chlorine, which are apparently not essential for growth, but which are still taken up in quantities comparable with those of group 1. It was believed until recently that the absorption of the mineral elements was dependent on recognized physical and chemical processes, and attempts have been made, with only very limited success, however, to make mechanical models which should act in the same manner as the root. This view has recently been replaced by one in which absorption is believed to be dependent on the vital activities of the root. According to this theory, part of the energy released by respiration is utilized in absorbing materials from the soil and in maintaining a higher concentration of these materials in the absorbing cells than in the soil. Respiration may be regarded as the process which keeps the pump running, enabling the latter to accumulate materials from the soil and to hold them at a much higher pressure (concentration) in the cell than in the soil. For continued uptake from the soil it is therefore necessary to ensure continual supplies of oxygen so that normal respiration may continue. Very recent research would seem to indicate that the absorption of water by the plant is dependent on some similar mechanism instead of on the simple capillary mechanism once believed in. In the case of water, however, the evidence is not, as yet, as conclusive as for the mineral elements.

The presence of open pores in the plant surfaces means that moist cell surfaces are exposed to the desiccating action of the atmosphere, and water is lost from these surfaces, as a consequence. By far the largest number of pores occur in the leaves owing to their great area, and so the greatest water loss takes place from the leaves. Most of the water taken up by the roots finds its way to the leaves to replace this loss. It moves through the vessels in the wood by suction. These vessels are long tubes which were once the walls of living cells, but which only serve for water conduction after the cell has died and the protoplasmic contents have disappeared. It has long been believed that the mineral elements are carried from the roots to the leaves along with the water current in the vessels, but proof of this view has only recently been forthcoming as a result of investigations at this Station.

The materials carried into the leaf by the transpiration current are absorbed from the dead vessels into the living cells surrounding them. All these materials, with the exception of calcium and iron, and the sugar elaborated in the leaf, are then distributed to other parts of the plant. The channel by which they are distributed, the reasons for their distribution and the mechanism by which they are moved, have formed the main subject of investigation at this Station. It would appear that longitudinal movement through the plant is largely confined to the inner bark and particularly to specialized cells known as sieve-tubes. Movement about the plant consists of two phases, in lateral movement into and out of the sieve-tube system and in longitudinal movement through the sieve-tube system. The sieve-tubes are long narrow cells joined end to end, with perforations in the end cells—hence the name of sieve-tubes. They form continuous channels from one end of the plant to the other, from shoot to root, and from leaf to boll. The earlier experiments of the Station indicated that each material moves from a region of high to one of lower concentration in the sieve-tube system and never in the opposite direction, and that they move quite independently of one another. It is clear that movement cannot be due to a movement of solution as a whole, such as takes place in the vessels in the wood, although this belief appears to be widely held, as for example, in the idea of a descending sap stream in the bark. The observed facts concerning movement indicate that it is controlled by diffusion, but this inference received a serious set-back when it was found that the rate of movement in the sieve-tube system was many thousands of times greater than any known case of diffusion in water, or for that matter, in any liquid. More recent work at the Station has shown that this high rate of movement is dependent on respiration, for when oxygen is withheld from a portion of the bark, movement through the sieve-tube in that bark is retarded, and may, if the reduction in oxygen supply is sufficiently great, be entirely stopped. Our present view on sieve-tube transport is that movement takes place by diffusion through a liquid medium entirely different from the known range of inorganic and organic liquids, which is maintained in some peculiar state of organization permitting extraordinarily high rates of diffusion by the energy released in respiration.

From earlier work at this Station it was inferred that materials moved from a region of high to one of lower concentration. Later work has shown that this inference holds only for movement through cells of the same type, as for instance, through the sieve-tube system, but that movement between cells of different types may be from high to low or from low to high concentration. Some investigations on movement between bark and leaf and between the flower and its stalk have, however, given us a clue to the causes underlying movement. It would seem that the properties of protoplasm depend on the type of tissue in which it is located. It may be, perhaps, that the variation in properties from one tissue to another is dependent on varying intensities of respiration. Thus sugar would appear to be much more soluble in the protoplasm of the sieve-tube than in the protoplasm of the leaf cells; in other words, the solvent capacity of the sieve-tube protoplasm for sugar is higher than that of the leaf cell. We have found that movement occurs in response to differences in the extent of saturation of solvent capacity in different cells, and always from a cell with a more nearly saturated to one with less saturated solvent capacity irrespective of what the actual gradients might be. An example may make this clearer. Suppose sugar is ten times as soluble in the sieve-tube protoplasm as in the leaf cell protoplasm. If the concentration in the leaf cell falls below one tenth of that in the sieve-tube, sugar will move from the sieve-tube to the leaf cell. If it rises above one tenth, the movement will be in the opposite direction. Movement will proceed in both cases until the concentration in the leaf cell is one tenth of that in the sieve-tube. It should be noted that while movement is taking place from the leaf cell to the sieve-tube it is against the actual concentration gradient and with it when in the reverse direction.

In the case of movement along a single tissue, the effect of solvent capacity does not normally come into play, for all similar cells would have the same solvent capacity, under similar conditions. In this case movement will be determined by the actual concentration gradients, as in the sieve-tube system. To sum up this section on movement, we may say that movement, both lateral and longitudinal, is caused by differences in the degree of saturation of solvent capacity and always takes place from a region of higher saturation to one of lower saturation. The mechanism of movement in the sieve-tube system is in some unknown manner dependent on respiration. We have as yet no experimental evidence concerning the mechanism of movement between tissues of different types, but since the cause is the same as for movement along a single tissue, it seems reasonable to suppose that the mechanism is the same in the two cases.

The new conceptions on uptake from the soil and movement in the plant permit a much clearer understanding of the processes going on in the plant than has hitherto been possible. The life cycle of an annual cotton plant such as Sea Island can conveniently be divided into two periods, vegetative and reproductive. In the first, the plant is predominantly vegetative, and in the second predominantly reproductive in habit, the vegetative growth decreasing as flowering and bolling progress towards their maximum. During the first, or vegetative stage, sugar is abundant in the plant. Absorption of mineral elements by the roots proceeds rapidly, and these, after distribution from the leaf are partly utilized for growth and partly stored. This storage is not dependent on the absorption of a surplus by the roots, for even when the supply of a particular material is so short that it is restricting growth, a portion of that absorbed is stored in such a manner that it is unavailable for vegetative growth. When flowering and bolling set in, the bolls divert more and more of the available sugar to themselves, and consequently the supply to the roots becomes more and more restricted. They are able to do this because the concentration of sugar in the boll is maintained very low by its continual removal from solution for growth purposes. Uptake by the roots falls off and the developing bolls now draw upon the stored materials throughout the plant for their supplies. The leaves become less and less effective photosynthetically as the mineral elements are drained from them and fall off. The shortage of sugar and the mineral elements finally become so intense that developing buds and bolls are themselves starved and shed. The plant fruits itself to senescence.

The size of the crop that can be carried by the plant is thus largely determined by the quantities of materials stored when bolling commences, and this in its turn is determined by the conditions prevailing during the vegetative stage. The dependence of the reproductive stage on the preceding vegetative phase has enabled us to use the state of affairs in the plant when bolling commences as an indicator of the plant's potential reproductive capabilities. This procedure has several advantages, the chief one being that we can measure the potential fruiting capacity and are not dependent on the actual yield which may be considerably affected by climatic and other environmental factors operating over the reproductive stage. Another advantage is that results of comparative trials can be obtained in a much shorter time.

In the preceding section, shedding of leaves and bolls was ascribed to food starvation. In the case of the leaf, the actual separation of the leaf is now known to be caused by a shortage in the supply of a hormone which would appear to regulate the growth rates of the leaf stalk and the subtending branch. Any marked change in the relative growth rate seems to cause shedding. Such change appears to be associated with changes in the food supply of the leaf. Thus rapid changes in the water supply, or shortage of sugar, or the addition of large quantities of fertilizer, all cause shedding. If a similar factor is the cause of boll shedding, and there seems no reason to doubt that this is so, it seems unlikely from the physiological standpoint that shedding will ever be controllable, except perhaps on a laboratory scale. The more obvious line of control seems to be the selection of types in which the shedding mechanism is not so well developed.

The importance of the vital activities of protoplasm in controlling the absorption of the plant's foods, and their subsequent distribution throughout the plant has led us to investigate the part played by the essential mineral elements in modifying protoplasmic activity. The case of potash is perhaps a little more simple than that of the other essential elements, for so far as we know, it is not a constituent part of the protoplasmic molecule nor of any such accessory compound such as chlorophyll. For some years it has been believed that potash exercises a controlling influence on photosynthesis, and we have very recently confirmed this. We have also found that it also exerts a controlling influence on the rate of transport through protoplasm. Thus under conditions of potash starvation, both photosynthesis and transport proceed at subnormal rates. As potash becomes more plentiful both rates increase and then, as the supply becomes excessive, the increase is changed to a decrease. Thus the optimum potash supply brings about the maximum rate of photosynthesis and the maximum rate of transport—obviously the best condition for the growth of the plant as measured by dry weight increase. Furthermore there is a direct relation between potash supply and the ratio of the dry weight of the leaves to that of the rest of the plant, so that we may be able to use changes in this ratio as an indicator of the effect of added potash. If field tests confirm the relation, it may well form the basis for a simple, rapid and exact method of determining the state of potash nutrition of the plant. This type of investigation is already being extended to minerals other than potash, but so far no such clear-cut results have been obtained as for potash.

The quantities of materials absorbed by the plant roots are determined largely by the concentration of these materials in the soil solution. Thus a high concentration of potash in the soil solution leads to a high uptake of potash by the roots, irrespective of the plant's requirements for potash. In other words, the plant absorbs what is supplied to it and not what it really needs. We know that sub-optimal and super-optimal supplies of an essential element both lead to diminished growth. It occurred to us that the amount of a mineral element taken up by the plant could be divided into two fractions, one used in furthering growth as measured by increased dry weight production, and one not so utilized, which might be designated as the luxury consumed fraction. Our first idea was that that fraction of an element in solution in the plant sap would represent the luxury fraction while the remainder would be the utilized fraction. According to this idea, increased supplies of an element limiting growth should cause an increased utilization, along with a decrease in the sap concentrations, of other essential elements and an increased dry weight. This idea worked quite well for nitrogen and phosphorus with potash limiting under controlled conditions in the greenhouse. Thus, as the supply of potash was increased from acute starvation level, the proportion of nitrogen and phosphorus in the sap decreased with a corresponding increase in the insoluble fraction. This was accompanied by an increase in the size (dry weight) of the plant. Then, as a sufficient level was reached and passed, the change in the ratio of utilized to luxury material and the increase in dry weight ceased. Finally, with supplies of potash greatly in excess there was a slight decrease in the size of the plant. The uptake of potash by the plant increased steadily throughout with the increasing potash supply. With nitrogen, the tolerance of excess is not nearly so great, and supplies only slightly over the optimum will cause decreased dry weight production. Extension of experiments to the field scale has introduced a further factor in that root room is not restricted as in the greenhouse pot plants. There are indications, however, that the method will prove of considerable value for field trials for the diagnosis of mineral deficiencies and excesses.

Potash behaves in a different manner from nitrogen and phosphorus, as might be expected from its non-participation in the protoplasmic molecule. It would seem that the fraction present in solution in the sap is the essential one, and not the solid fraction as in the case of nitrogen and phosphorus. Potash starvation is shown in bark and old leaves by the absence of any insoluble potash, whereas with super-optimal supplies a considerable proportion of the potash in these tissues may exist in the solid form. With young leaves, whether under conditions of shortage or excess, a considerable proportion of their potash content occurs in the solid form.

During our experiments on potash we have noticed that it is washed out of the leaf with great ease by rain and dew, far more easily, in fact, than any other element in the plant. We have not made any estimation of the extent to which the loss can attain, but some indication of this can be obtained from the concentration of 0·4 grm. potash/litre found in dew during a heavy fall. The average potash content of a leaf with an area of 1 sq. decm. and weighing 2 grm. is of the order of 5 to 10 mgrm. so that 15 to 25 ml. of dew would contain as much potash as the leaf. Although the concentration of potash in the dew would be expected to decrease as leaching progressed, this calculation serves to illustrate how important a factor the loss of potash by rain and dew may be in the humid tropics.

An interesting investigation which we have just commenced concerns the relative toxicity of certain elements to plants and insects. This was suggested by some recent American work on the relative toxicity of selenium—an element which is not essential for growth—to plants and animals. This element, which is similar to sulphur in its chemical properties, appears to be much more toxic to animals than to plants, and we are at present investigating the possibility that feeding cotton plants with small doses of selenium and other metals such as arsenic may cause them to become poisonous to insects which feed on them without in any way harming the plant.

In conclusion, it seems advisable to outline possible practical applications of the results of the investigations described above. The aim of the physiologist in agriculture must be to see that plants in his charge are grown under the best possible conditions. Some of the conditions such as light and temperature are largely beyond control, and in such cases he must try to offset possible detrimental effects. For example, potash has a stimulating effect on photosynthesis and so should be of particular advantage when light is limiting photosynthesis. Furthermore, such a condition is often associated with increased rainfall which would cause increased loss of potash by leaching. It would seem advisable therefore that potash should be added during dull wet weather, not only to stimulate photosynthesis, but also to bring about increased uptake and so counteract the leaching loss. The physiologist must see that the plant makes the best use of nutrients already present in the soil, remembering that soil aeration is of the utmost importance in this respect. It is very probable that the basic reason for such practices as ploughing, forking, draining and liming is to ensure adequate aeration of the soil. In this connexion it may be of interest to mention that we have found that damage by fungi to roots of plants grown in water culture can be considerably reduced by aeration and also by increased calcium supplies. After having ensured adequate soil aeration the physiologist is then faced with the difficulty of determining whether any of the materials supplied are deficient. At present there is no satisfactory method for doing this. It has long been realized that different varieties of plants have different feeding powers and that what may support one plant may be hopelessly inadequate for another. For this reason, attempts have been made to use plants instead of solvents to extract the available nutrients from samples of soil, as in the Mitscherlich and Neubauer methods, but such methods are by no means an unqualified success. The method at present available is that of field trials. This gives results only for those particular elements added as fertilizers, and moreover such results may take a considerable time to obtain. We believe that our investigations on the effect of added increments of one element on the state of other elements in the plant may lead to a solution of this problem. Thus in one of our field experiments on the effect of increasing potash supplies, the results obtained indicated that while potash was limiting growth at the lower potash levels, magnesium was the limiting factor at the higher potash levels, a result which could not have been obtained by any of the existing methods. This method requires analytical experience and equipment, but we hope that our studies on the effect of the various mineral elements on protoplasmic activity will lead to much simpler methods for the diagnosis of the nutritional status of single elements. As an example of this latter type, we will refer to the possibility, already noted, that the correlation between the distribution of dry matter between the leaves and the rest of the plant and the potash supply to the plant may be useful as an indicator of the adequacy or otherwise of the latter.

Received February, 1937.

THE RÔLE OF "DEFLOWERING" IN COTTON PRODUCTION

BY

B. N. SINGH, D.Sc.,
Director, Institute of Agricultural Research, Benares Hindu University, India,

AND

R. S. CHOUDHRI, M.Sc.

WITH progress in the standard of living, the demand for cotton has greatly increased. To meet this demand many have advocated the encouragement of cotton growing in the Empire, and particularly in India, which is so well suited by its soil, climate and large population for the cultivation of this plant. The investigations upon cotton at this Experiment Station (1, 2, and 3), carried on with the view of improving the quality and ginning out-turn, were undertaken mainly to suit the needs of untrained cotton growers. In the present work, the merely mechanical practice of " deflowering," adopted to give each branch of the plant room to fruit freely and thereby to obtain an increase in the yield, is dealt with.

POT CULTURE.—Field experiments are subject to a multiplicity of factors, and rarely give clear-cut results. Recourse was therefore had to pot culture experiments under controlled conditions of factor intensity, and the observations were later confirmed through replications in the field. A number of large, glazed, well-drained, earthenware pots of similar size, containing a uniform mixture of soil and manure, were employed. Pure strains of *Gossypium neglectum* (var. W. N. 27 Desi)* were selected, graded as far as possible for uniformity in size and weight, and sown in large numbers per pot. After germination the seedlings were thinned down to only a few (or even one in certain cases) in the individual pots. Watering and hoeing were carried out at regular intervals in such a way that the saturation limit was kept within the range of ±1·5 per cent. Soil pH was maintained at 6·5. The soil temperature, though varying considerably from germination to picking, was held constant within about ±0·5° C. in the different sets.

---

* A selection for high yield and not lint length.

DEFLOWERING.—The term " deflowering " is used for the removal of flowers, practised for a shorter or longer duration in different sets. The first flower appeared on the eighty-sixth day in some plants in each of the series segregated for experimentation, and others subsequently. From one of these sets, the flowers were removed continuously for a fortnight. This set was named the deflowered " A," while with another, the deflowered " B," the practice was prolonged for fifteen days more. To obtain comparative observations, a third set was maintained as control, from which no flowers were removed and in which plants were grown under conditions of factor intensity strictly identical with those in " A " and " B."

BRANCHING.—Of the many interesting features that followed the practice of " deflowering," the variations introduced in the branching system of the plants need mention. The majority of plants for over two months and more after germination grew only along the main axis monopodially. The soil temperature during these months averaged $35 \pm 0{\cdot}5°$ C., and hence plants seemed to get no opportunity to develop branches, which appeared only later when the temperature fell.

As a result of " deflowering," a number of additional branches appeared gradually on the plants (Plate I.). Unlike the slender branches of the normal plants, these were more scattered, spreading, stocky and horizontal. An excessive development of branches at the lower nodes gave the plants a bushy appearance, while those at the lower nodes in the normal plants were only rudimentary, short and abortive. In the normal plants the ninth or tenth node was the first at which fruiting branches were produced; in the deflowered, fruiting branches were usually found at node five or node six, or even much below on the stalk where the practice of " deflowering " was prolonged.

REPRODUCTIVE INITIALS.—After " deflowering " plants blossom in a much more compact and symmetrical way. In the normal plants, the reproductive activity is shown in varying stages of development from exceedingly small buds completely covered by the involucral bracts on the one hand to bolls ready for picking on the other (Table I.). In the deflowered plants such stages are considerably curtailed in relation to the controls. In cases when the practice of " deflowering " is prolonged a chain of developmental stages is not present at all.

The absence of alternate stages in the developmental gradation of flowers in the deflowered set " A " and the disappearance of a continuous chain in " B " might lead one to suppose that there was a proportionate diminution both in the total number of reproductive initials borne by the individuals, and in the out-turn resulting from these plants. When the reproductive initials of approximately identical stages of development are graded, the number does not exceed five in the controls. In the " deflowered A " the number of such initials is invariably over five and sometimes reaches to thirteen. In " deflowered B " this number often increases beyond forty, a figure far greater than the total number present on the average control. The general appearance of the deflowered plants is thus vastly improved, and their tendency to flower freely is increased much beyond the normal.

TABLE I.

COMPARATIVE STUDY OF THE REPRODUCTIVE INITIALS BELONGING TO DIFFERENT SETS AT THE TIME OF FIRST PICKING IN " DEFLOWERED A."

No.	*Stages of the Reproductive Initials.*	*No. of Reproductive Initials in—*		
		Control.	*Deflowered* " A."	*Deflowered* " *B.*"
1	Buds small, completely covered by involucre	5	7	20
2	Buds more developed, covered by much bigger involucral bracts	3	—	—
3	Buds with involucral bracts gaping apart to give way to K	1	13	43
4	Flowers with both involucre and K open to give way to C	4	—	23
5	Flowers more developed with involucre, K and C open to a greater extent	5	9	3
6	Flowers at the period of fertilization ..	3	—	13
7	Flowers with developed ovary (beginning of boll formation)	5	7	11
8	Developed capsules with involucral bracts and K at the base	2	—	—
9	Half-open bolls	2	6	—
10	Bolls ready for picking	3	10	—
	Total ..	33	52	113

[K=calyx, C=corolla.]

GROWTH BEHAVIOUR.—After " deflowering " the plants are more free in their growth and also more prolific than those raised without it. The stems of such plants are much thicker, bearing greater numbers of pubescent leaves with prominent veins and with increased surface area. The accumulation of dry matter is greater than that

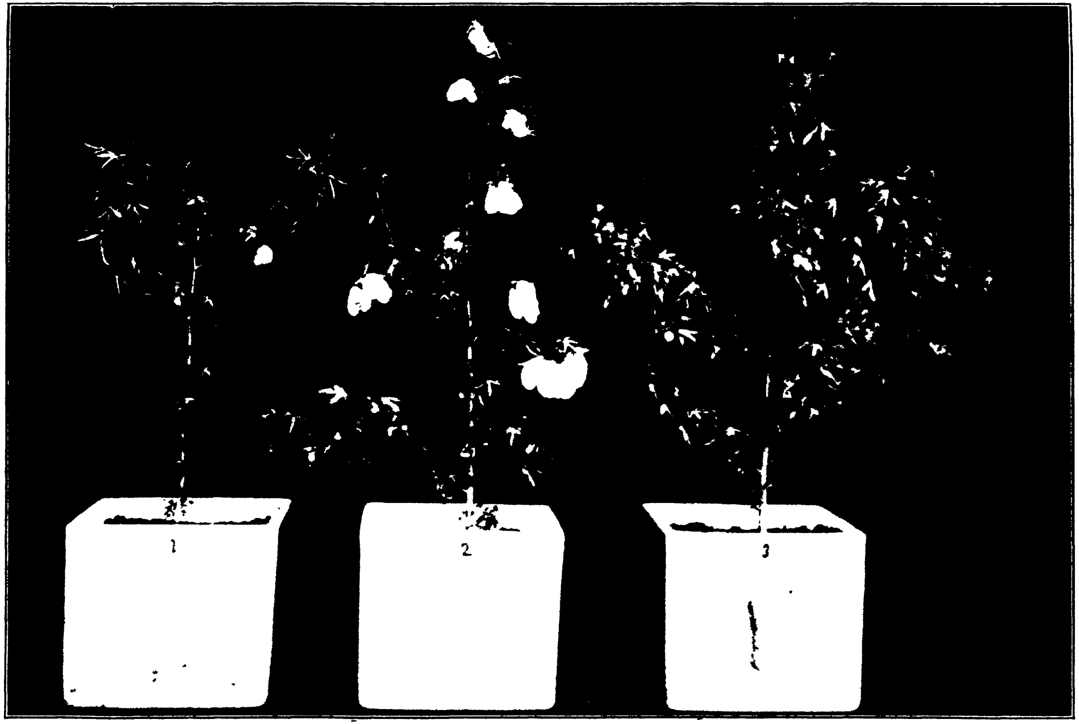


PLATE I.—AVERAGE PLANTS FROM CONTROL AND DEFLOWERED SETS, PHOTOGRAPHED AT THE TIME OF FIRST PICKING IN DEFLOWERED "A" TO SHOW COMPARATIVE VARIATIONS IN BRANCHING AND OTHER GROWTH CHARACTERISTICS.

1, Control. 2, Deflowered "A." 3, Deflowered "B."

TABLE II.

Showing Variations (Final) after Deflowering in Average* Height, Dry Matter Accumulation, No. of Flowers, No. of Bolls, Quantity of Seed Cotton and Ginning Out-turn, etc.

Particulars.	*Normal.*	*Deflowered " A."*	*Deflowered " B."*
1. Average height per plant in cm. with standard error	59·8 ± 1·021	80·3 ± 0·884	80·1 ± 0·975
(*a*) Standard deviation of the mean	10·21	8·84	9·75
(*b*) Difference of means with standard error	—	20·5 ± 1·350	20·3 ± 1·412
(*c*) Difference/standard error	—	15·18	14·37
(*d*) Deflowered/normal	—	1·34	1·34
2. Average dry weight (final) per plant in gm. with standard error	50·4 ± 0·862	72·6 ± 1·364	96·3 ± 1·820
(*a*) Standard deviation of the mean	8·62	13·64	18.20
(*b*) Difference of means with standard error	—	22·2 ± 1·613	45·9 ± 2·014
(*c*) Difference/standard error	—	13·76	22·79
(*d*) Deflowered/normal	—	1·44	1.91
3. Average no. of flowers per plant with standard error	97·0 ± 0·881	126·0 ± 1·604	146·0 ± 2·011
(*a*) Standard deviation of the mean	8·81	16·04	20.11
(*b*) Difference of means with standard error	—	29·0 ± 1·830	49·0 ± 2·196
(*c*) Difference/standard error	—	15·84	22·31
(*d*) Deflowered/normal	—	1·29	1·50
4. Average no. of bolls per plant with standard error	43·0 ± 0·939	61·0 ± 0·699	79·0 ± 0·918
(*a*) Standard deviation of the mean	9·39	6·99	9·18
(*b*) Difference of means with standard error	—	18·0 ± 1·170	36·0 ± 1315
(*c*) Difference/standard error	—	15·38	27·37
(*d*) Deflowered/normal	—	1·41	1·83
5. Average quantity of seed cotton per plant in gm. with standard error	78·2 ± 1·058	145·1 ± 0·913	—
(*a*) Standard deviation of the mean	10·58	9·13	—
(*b*) Difference of means with standard error	—	66·9 ± 1·397	—
(*c*) Difference/standard error	—	47·88	—
(*d*) Deflowered/normal	—	1·85	—
6. Average quantity of ginning out-turn per plant in gm. with standard error	30·1 ± 0·722	61·0 ± 0·673	—
(*a*) Standard deviation of the mean	7·22	6·73	—
(*b*) Difference of means with standard error	—	30·9 ± 0·987	—
(*c*) Difference/standard error	—	31·30	—
(*d*) Deflowered/normal	—	2·00	—

---

* Average of observations on 100 plants in each case.

of the control plants at successive stages after "deflowering." Too much "deflowering" is liable to stimulate an extensive development of vegetative growth at the expense of fruit formation. Deflowered plants are on the whole tall and bushy and possess high yielding capacity and longer life-cycle (Table II.).

Picking.—The usual practice of the small-scale cotton growers in the United Provinces is to pick the cotton from their fields at intervals of four to five days at the beginning, followed by pickings on alternate days when enough of the bolls ripen. The pickings in such cases are traditionally done on a share basis, where the pickers endeavour to increase the quantity so as to obtain the maximum possible share, spending as little time as possible, without the least consideration of quality. The cotton thus picked is mostly neppy and uneven.

The large-scale growers, on the other hand, employ the pickers on wages; and with the view of reducing the amount that they pay, the number of pickings is usually curtailed to few, so that a good proportion of the cotton falls upon the ground and becomes soiled. In such a state of affairs, it becomes imperative to pay some "on" allowance if cleaner pickings are desired.

As a result of "deflowering" a large number of bolls ripen at a time at much longer intervals, and the number of pickings is thus naturally curtailed. Much of the difficulty in obtaining cleaner pickings can possibly be solved in this way without providing any "on" allowance to the pickers. The uniformity in ripening of the bolls automatically brings about a uniformity in colour and length of lint.

Ginning Out-turn.—The ginning out-turn from plants belonging to set "deflowered 'A'" is fairly high in comparison with the one obtained from control plants. Set "B," however, hardly gives any profitable yield owing to a considerable delay in obtaining maturity, and the bolls formed in this case do not get conditions suitable to their ripening.

The quantitative increase in seed cotton after "deflowering" (Tables III.-IV.) is mainly due to the following:

1. Increase in the number of fruiting branches,
2. Increase in the tendency to flower freely,
3. Increase in the resistance of bolls to the usual shedding,* and
4. Increase in the size and productiveness of bolls, etc.

---

* Insufficient supply of nutritive material from the vegetative parts of the plant has been pointed out (5) as one of the causal factors in the usual excessive shedding of flowers and bolls. "Deflowering" seems to solve the problem in part, due probably to the attainment of a greater physiological balance in the plant.

TABLE III.

Sets.	*Seed Cotton per Boll (Gm.).*	*Lint per Boll (Gm.).*	*No. of Seeds per Boll.*	*Lint per Seed (Mgm.).*	*Seed Weight (Mgm.).*
Normal	1·82	0·70	20 (7+7+6)*	35·0	56·0±0·602
Deflowered " A " ..	2·38	1·00	23 (8+8+7)*	43·4	60·0±0·571
Deflowered " B " ..	Bolls fail to ripen.				

* Indicates the number of seeds in different locks of the individual bolls.

TABLE IV.

Sets.	*Percentage of Bolls to Flowers.*	*Percentage of Lint in Seed Cotton.*	*Percentage Increase over Normal in—*		
			Lint per Boll.	*Lint per Plant.*	*Average Individual Seed Weight.*
Normal	44·3	38·4	—	—	—
Deflowered " A " ..	48·4	42·0	+42·8	+97·4	+7·1
Deflowered " B " ..	54·1	—	—	—	—

The lint obtained from control plants is lacking in uniformity of colour and length. The colour varies from brownish to creamy-white and the length from 12·5 mm. to 13·6 mm. (Table V.). The superiority of lint obtained from the deflowered plants is due to the following:

1. Cleaner pickings,
2. Greater uniformity in staple length,
3. Greater uniformity of staple colour, and
4. Increase in the staple length.

A mathematical expression of the data clearly indicates the greater uniformity of lint characters (the range of variation being narrow) after " deflowering " as compared with the control.

Since the samples employed for observation in this investigation were fairly large and the conditions in which the plants were grown fairly uniform, the average results obtained seem to represent a true stimulation due to " deflowering," and not a chance variation. The significance of the results is further evidenced by the fact that the

TABLE V.

AVERAGE LINT CHARACTERS WITH STANDARD ERRORS AND COEFFICIENT OF VARIATION* OF *Gossypium neglectum* (var. W.N. 27 DESI) WITH AND WITHOUT "DEFLOWERING."

Sets.	*Lint Length.*		*Lint Index.*		*Lint per Cent.*	
	Mean (Mm.).	*Coefficient of Variation (per Cent.).*	*Mean (Gm.).*	*Coefficient of Variation (per Cent.).*	*Mean (per Cent.).*	*Coefficient of Variation (per Cent.).*
Normal	12·5 ±0·165	13·2	3·50 ±0·024	6·85	38·4 ±0·450	11·7
Deflowered "A" ..	13·6 ±0·093	6·8	4·34 ±0·018	4·14	42·0 ±0·234	5·8
Deflowered "B" ..	—	—	—	—	—	—

* Coefficient of variation $= \frac{\sigma}{M} \times 100$, where M is the mean of 100 samples.

difference of means between the deflowered and the normally grown plants or between the samples obtained from them is invariably over twice the standard error.

CONCLUSION.

The marked increase in the resistance to shedding, in the size and weight of the bolls, in the weight of the seeds and in the abundance of better lint makes the importance of short-durationed "deflowering" obvious. Through the practice of "deflowering" the time of the ripening of bolls can be adjusted at will, especially in view of combating unfavourable weather conditions—*e.g.*, over-wintering or excessive rainfall. "Deflowering" may be continued for a longer time in case of early sowings (sowings done even before the first shower), but should not be carried on when, owing to continuous rainfall or to the lack of facility on the part of the grower, sowings are done late in the season.

Previous investigations (2) as well as the present indicate clearly that cotton can be grown very successfully in this tract. In order to provide room for "deflowering" sowing should be accomplished in the beginning of the summer and the plants should be maintained by irrigation till the monsoon rains commence.

REFERENCES

1. INAMDAR, R. S., SINGH, S. B., AND PANDEY, T. D. " The Growth of the Cotton Plant in India." Part I., *Ann. Bot.*, 39, 1925.
2. INAMDAR, R. S., AND SINGH, B. N. " The Growth of the Cotton Plant in India." Parts II., III. and IV., *Agric. Jour. Ind.*, xxv., 11, 1930.
3. SINGH, B. N. " The Growth of the Cotton Plant in India." Part V., *Agric. Jour. Ind.*, xxv., 11, 1930.

Received October, 1936.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

THIS time last year we wrote: " During the last two years the outstanding feature of cotton statistics has been the great change, both as regards production and consumption, in the relative figures of American and Outside Growths." This year that position has become still more acute. A year ago we were stressing the fact " that the total of Outside Growths is once more fully *five* million bales above the American production." The figures we gave in the January issue this year showed totals of 18,531,000 Outside Growths against 12,407,000 American (excluding linters), a difference of fully *six* million bales. Since then, as will be seen from the summary given in the special article on page 113 of this issue, the position has become even more marked, for the total of Outside Growths is now 19,573,000 bales, or fully *seven* million bales more than the American crop, for which, of course, no new figures are available since December.

Indian.—As regards the Indian crop, of which particulars are given in our first table, it is now possible to give more definite figures. The so-called " Final " estimate, issued in February (which, however, is subject to revision in the " Supplementary " estimate in April), is 5,959,000 bales, and confirms the prospect of a further slight improvement on last year's figure of 5,728,000 bales, which was the best since 1928, but not a record, for the Government figure was 6,215,000 bales in 1925-26. The area, however, shows hardly any change on last year, and the average yield of 95 lbs. per acre is the highest since 1927.

This year there has again been frost in the Broach and Dhollera areas, a very unusual occurrence, though it also happened in January, 1935. Probably as the result of this frost Ralli Bros. have now reduced their estimate of this year's crop to 7,724,000 bales.

The details by varieties in the February estimate have, of course, not been cabled, but judging by the December figures it looks as if the percentages of long and short staples for the season would be very close to those of last year. But this is subject to the fuller detailed statement the Government will issue later, showing a more accurate subdivision of some of the crops, which, for example, allocates part of the Broach crop and now also part of the Westerns and Northerns crop to short staple instead of long. We hope to have the details of this in time for inclusion in the July issue.

Sudan.—The Sudan Government again issued no estimate of the Gezira crop until January, but the figures now available, which are given in our second table, are on the whole very satisfactory. The total area shows a substantial increase on last year, which is about equally divided between Sakel and American. The estimate of the Gezira crop is as good as could have been expected in view of the late October rains, which in previous years have frequently resulted in damage to the crop through black-arm and leaf curl. The big increase of the Tokar crop is less than it should have been in view of the increase of acreage. In Kassala (River Gash area), the average yield is better than last year, and the reduced crop is due to a smaller acreage. The American irrigated crop is doing very well on a slightly smaller acreage, but the raingrown with a substantial increase of acreage shows a crop not much larger than last year.

Consumption.—As to consumption, the main feature of this season so far has been the enormous increase of consumption in America (shown in our next table), which in December just failed to break the previous record for all time of 697,261 bales in June, 1933. January would certainly have done so, but for the strike in the motor industry in America. The result is that the United States consumption of All Kinds for the first half of the season is 3,848,195 bales, indicating a season's total of at least 7,700,000 bales compared with the previous record of 7,189,600 bales in 1926-27.

But while consumption has been going ahead at a terrific pace in the United States, where, of course, it is almost entirely of their own cotton, the consumption of American cotton in the rest of the world has fallen very badly behind. For this we have at present only Garside's estimates, and it is doubtful whether the Federation's figures will be out in time for this issue. We therefore give here a summary of Garside's figures for the first six months of the season with previous half years for comparison. The crux of the whole position is that owing to the decline in the consumption of American outside of the U.S.A., the world's total consumption of American is little more than a year ago, whereas the world's consumption of Outside Growths is again showing new record figures. If the recent pace of accelerated consumption is maintained we may easily see a world's consumption this year of over twenty-nine million bales of all kinds; but the distribution of that total is likely to be of the order of 12,750,000 bales of American and 16,500,000 of Outside Growths!

GARSIDE'S COTTON CONSUMPTION.

1934–35.	*American.*		*Total.*	*Outside Growths.*	*All Kinds.*	*Outside Growths per Cent. on Total.*
	U.S.A.	*Other Countries.*				
First half	2,622	3,043	5,665	7,249	12,914	56·1
Second half	2,619	2,922	5,541	6,973	12,514	55·7
Total ..	5,241	5,965	11,206	14,222	25,428	55·9
1935–36.						
First half	2,954	3,194	6,148	7,386	13,534	54·6
Second half	3,267	3,124	6,391	7,804	14,195	55·0
Total ..	6,221	6,318	12,539	15,190	27,729	54·8
1936–37.						
August	562	417	979	1,264	2,243	56·4
September	615	389	1,004	1,349	2,353	57·3
October	633	409	1,042	1,421	2,463	57·7
November	614	438	1,052	1,394	2,446	57·0
December	679	453	1,132	1,422	2,554	55·7
January	664	446	1,110	1,421	2,531	56·1
First half	3,767	2,552	6,319	8,271	14,590	56·7

Monthly Carryover of American.—Even by the end of December, the monthly figures of the World's Carryover of American cotton were showing the effect of the enormous consumption in America. The critical point in the monthly history of the American Carryover always is whether the figure turns downwards at the end of December or not till the end of January. Only in five years out of the twenty-five since publication of these figures first began has the turn come in December, but this year the reduction in December (298,000 bales) was the largest on record, and January showed almost as favourable a comparison. It is doubtful whether the Federation figures of Mill Stocks in other countries, which are required to complete the Mid-Season Carryover, will be available before this issue goes to press.

Prices.—American prices have been very strong during the last three months, partly because the December crop estimate checked the series of increases from the low figures of September and practically restored the original estimate of August. But the rise throughout December and January was also due to the big consumption in America, as well as to the general rise in the prices of primary commodities, in which it was felt that cotton had not had its share. During January prices were for a time checked by the Government proposal to release as much as was required of their three million bales of Loan cotton, at a price which it was thought would work out at 12·50 cents. This for a time acted as a " ceiling " to the market; but towards the end of the month the announcement of the details of the scheme produced the impression that the " ceiling " would be at least twenty-five points higher, and January touched a new high level which for Liverpool was the highest since August, 1934. In February, however, after a slight reaction the rise was resumed and carried still further early in March, largely as the result of the prospect of huge expenditure on armaments, so that new high records since 1929-30 were reached.

In Egypt Uppers more than followed the rise of American, but the position of Sakel since November has once more demonstrated the extremely unsatisfactory position of the Liverpool Sakel contract, which declined heavily until the middle of February under the fear that the principal operator would tender the heavy deliveries he had to take up in November against either the Sakel or the new Giza 7 contract in Liverpool, but has since made a marked recovery. The result has been that the Giza 7 contract has followed the movements of Sakel. It will be a great relief to the market when the Sakel contract finally disappears next September and Giza 7 takes its place as the ruling contract for long staple Egyptian.

Our last table, which gives Liverpool spot prices of American, with other varieties as percentages thereof, shows again what has now come to be recognised as almost a normal tendency, namely that when American goes up the prices of other varieties tend to fall behind relatively. This, however, is notably not so in the case of Tanguis and Uppers, which have appreciated considerably as against American. That may be partly explained by the belief that the disastrous floods in the Upper Mississippi Valley would mainly affect the supplies of staple cotton in the Memphis district, but that danger appears now to have passed. This tendency was probably also accentuated by the very marked failure in the quality of the 1936 crop in Texas, which used to be the main source of supply of good staple American cotton.

INDIAN CROP.

(000's *Omitted.*)

	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.[1]
Area (acres)	23,722	22,483	24,137	24,023	25,138	25,050
Crop (Government estimate) 400-lb. bales	4,007	4,657	5,108	4,858	5,728	5,959
Average yield per acre (lbs.)	68	83	85	81	91	95
Staple ⅞ and above (bales)	1,306	1,347	1,365	1,255	1,813	—
Per Cent. of Total ...	*32·6*	*28·9*	*26·7*	*25·8*	*31·7*	*30·0*
Staple below ⅞ (bales) ...	2,701	3,310	3,743	3,603	3,915	—
Per Cent. of Total ...	*67·4*	*71·1*	*73·3*	*74·2*	*68·3*	*70·0*
Commercial Crop :						
Net exports (bales) ...	1,582	2,868	3,406	3,115	—	—
Mill consumption ...	2,346	2,361	2,336	2,612	—	—
Domestic consumption ...	750	750	750	750	—	—
Total	4,678	5,979	6,492	6,477	—	—
Per cent. on Government estimate	+16·7	+28·4	+27·1	+33·3	—	—
Season's average spot price (Liverpool—pence per lb.)	4·32	4·84	4·52	5·24	5·21	—
Per cent. on American ...	89·6	86·1	75·1	75·6	79·9	—

[1] February estimates.

SUDAN CROP.

	1935–36.				1936–37.*			
	Area: Feddans	*Crop: Kantars*	*Yield per Feddan*	400-*lb. Bales*	*Area: Feddans*	*Crop: Kantars*	*Yield per Feddan*	400-*lb. Bales*
Sakel :								
Gezira (Syndicate) ..	164,178	610,428	3·72	173,634	167,288	700,000	3·52	176,750
Gezira (Kassala Cotton Company) ..	20,562	77,232	3·76		31,837			
Tokar ..	14,053	34,029	2·42	8,422	43,000	80,000	1·86	19,800
Kassala (Gash Delta) ..	36,257	64,501	1·78	15,964	30,335	60,000	1·98	14,850
Others ..	8,070	25,367	3·14	6,279	11,979	44,800	3·72	11,088
	243,120	811,557	3·34	204,299	284,439	884,800	3·11	222,488
American :								
Irrigated ..	11,812	39,863	3·37	8,870	11,642	45,763	3·93	10,152
Rain-grown ..	123,036	118,782	0·97	26,429	161,300	129,040	0·80	28,712
Total ..	377,968	970.202	2·57	239,598	457,381	1,059,603	2·32	261,352

* Estimates only.

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

1934–35.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
May ...	469·2	20·6	458·8	1·4	5·7	3·4	65·5
June ...	385·9	19·3	376·8	1·3	4·6	3·2	61·9
July ...	391·8	17·8	382·0	1·3	4·7	3·8	62·1
1935–36.							
August ...	408·4	18·6	397·9	2·0	4·7	3·9	57·9
September ...	449·1	21·4	437·6	1·8	5·5	4·2	61·1
October ...	552·2	24·0	538·5	2·0	6.4	5·3	67·1
November ...	507·8	24·8	496·1	1·8	5·2	4·8	59·5
December ...	498·3	26·2	487·3	1·8	5·5	3·7	55·2
January ...	591·3	26·0	578·1	2·2	6·6	4·4	56·0
February ...	516·6	25·8	504·2	1·9	5·6	5·0	53·6
March ...	548·9	25·0	536·9	1·8	5·0	5·3	60·8
April ...	576·8	26·5	562·7	1·7	5·8	6·6	61·4
May ...	530·8	25·3	518·3	1·4	5·2	5·9	64·7
June ...	556·3	25.3	542·8	1·4	5·3	6·9	64·0
July ...	603·2	26·2	588·3	1·8	6·1	7·0	70·2
1936–37							
August ...	574·3	27·3	560·3	1·7	5·6	6·7	65·4
September ...	629·7	29·0	613·7	1·7	5·9	8·5	67·9
October ...	646·5	29·7	630·9	1·8	6·0	7·8	72·5
November ...	626·7	30·6	612·0	1·9	5·5	7·3	63·8
December ...	692·9	33·0	676 8	2·0	6·3	7·7	61·9
January ...	678·1	32·7	662·5	1·8	6·5	7·2	63·4

WORLD'S CARRYOVER OF *AMERICAN* COTTON.

(Running Bales 000's, excluding Linters in U.S.A.)

End of—	*Stock and Afloat.*			*U.S.A.*		*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*	*Elsewhere in U.S.A.**
	U.K.	*Continent.*	*Orient.*	*Mill Stocks.*	*Public Warehouses.*				
1930, July ...	304	544	143	1,048	2,803	4,842	937	6,249	470
1931, January ...	644	1,198	343	1,523	7,895	11,603	907	12,510	—
July ...	436	766	401	922	4,491	7,016	950	8,816	850
1932, January ...	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July ...	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January ...	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July ...	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
1934, January ...	617	1,367	752	1,557	9,469	13,762	1,320	15,082	—
July ...	405	734	590	1,172	5,526	8,427	1,132	10,509	950
1935, January ...	397	640	768	1,148	8,912	11,865	1,060	12,925	—
July ...	201	395	315	749	5,708	7,368	955	9,003	680
August ...	180	342	238	606	5,865	7,231	—	—	—
September	172	373	232	682	7,126	8,585	—	—	—
October ...	324	450	307	1,041	8,463	10,585	—	—	—
November	418	658	412	1,314	8,613	11,415	—	—	—
December	501	797	499	1,397	8,367	11,561	—	—	—
1936, January ...	493	614	565	1,405	7,823	10,900	858	11,758	—
February	463	637	457	1,372	7,223	10,152	—	—	—
March ...	420	665	405	1,302	6,543	9,335	—	—	—
April ...	385	593	371	1,155	5,992	8,496	—	—	—
May ...	362	523	323	1,053	5,205	7,468	—	—	—
June ...	356	471	251	944	4,498	6,520	—	—	—
July ...	321	359	195	855	3,907	5,637	792	7,004	575
August ...	280	291	172	710	4,304	5,757	—	—	—
September	322	430	254	811	6,773	8,590	—	—	—
October ...	382	519	352	1,367	8,003	10,623	—	—	—
November	381	600	444	1,760	8,395	11,580	—	—	—
December	460	613	470	1,971	7,768	11,282	—	—	—
1937, January ...	493	647	460	2,034	6,761	10,395	—	—	—

HIGHEST AND LOWEST FUTURES PRICES.

1935–36.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
August ...	11·60	*10·31*	6·22	5·63	7·86	7·58	7·04	6·42
September	10·81	10·31	5·97	*5·52*	8·01	*7·48*	6·82	*6·38*
October ...	11·27	10·54	6·21	5·77	8·42	7·78	6·87	6·51
November	11·97	10·86	6·54	6·07	9·51	8·44	7·77	6·82
December	11·77	11·01	6·49	6·14	9·20	8·57	7·71	7·28
January ...	11·58	10·90	6·24	5·77	9·22	8·54	7·53	7·03
February	10·99	10·63	5·87	5·62	8·81	8·29	7·14	6·84
March ...	11·34	10.59	6·08	5·66	8·76	8·34	7·20	6·90
April ...	11·31	10·80	6·11	5·83	8·72	8·45	7·18	6·94
May ...	11·58	11·02	6·13	5·93	8·68	8·48	7·30	6·95
June ...	11·79	10·60	6·34	5·79	9·20	8·44	7·45	6·84
July ...	*12·78*	11·51	*6·84*	6·23	*11·04*	9·14	*7·92*	7·35
1936-37.								
August ...	12·16	11·30	6·53	6·10	10·79	9·96	7·49	6·99
September	12·30	11·50	6·68	6·13	10·18	9·67	7·32	6·91
October ...	12·21	11·51	6·78	6·51	10·80	9·93	7·45	7·14
November	11·92	11·51	6·75	6·46	10·91	9·93	7·36	7·17
December	12·54	11·85	6·89	6·54	10·24	9·80	7·77	7·31
January ...	12·85	12·24	7·15	6·73	10·15	9·83	8·05	7·61
February	12·77	12·36	7·16	6·89	10·15	9·49	8·40	7·83

Maximum and minimum each season in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1935–36.	*American (Middling). Pence per Lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil.*		*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
				Pernam (Fair).	*San Paulo (Fair).*				
August ...	6·21	76·0	100·0	95·2	97·6	106·4	108·9	114·2	128·0
September	6·40	78·6	100·0	96·1	98·4	105·5	109·4	112·3	133·1
October ...	6·47	84·7	100·8	98·5	100·8	109·3	117·0	107·3	140·8
November	6·59	87·3	101·8	99·5	101·8	111·7	119·3	120·2	153·9
December	6·41	87·8	101·6	100·0	102·3	114·8	119·5	120·1	148·8
January...	6·14	82·9	101·6	100·0	102·4	113·8	121·2	119·1	157·8
February	6·04	82·3	100·8	99·2	101·7	111·6	121·5	116·9	149·5
March ...	6·44	78·6	100·0	96·9	100·8	110·1	119·4	114·4	142·9
April ...	6·62	76·6	100·0	97·0	100·8	109·8	118·9	112·5	138·2
May ...	6·64	72·6	99·2	94·7	99·2	106·0	118·1	113·6	130·6
June ...	7·18	73·8	98·6	93·0	95·8	104·2	115·3	112·3	128·8
July ...	7·10	79·6	97·9	92·3	94·4	103·5	115·5	126·1	158·2
Season's average	6·52	79·9	100·2	96·8	99·7	108·9	116·6	114·7	141·4
1936-37.									
August ...	6·70	74·0	97·0	91·8	94·0	104·5	117·9	117·3	153·4
September	6·73	76·1	99·3	94·1	96·3	106·7	117·8	109·5	150·8
October ...	6·81	74·0	100·3	95·2	97·4	106·9	123·0	106·5	167·6
November	6·72	75·0	98·8	95·1	97·3	107·7	124·1	109·8	170·4
December	7·10	75·4	98·6	94·4	96·5	107·0	125·4	110·3	146·5
January ...	7·34	73·3	98·6	94·6	96·6	106·8	130·7	111·9	139·6
February	7·41	71·0	97·6	92·8	96·2	106·3	130·0	114·3	137·8

THE EARLY DEVELOPMENT OF THE COTTON FIBRE

The following letter has been received by the Editor:

Agricultural Research Institute,
Coimbatore, Madras.
November, 1936.

Sir,

In the article "The Early Development of the Cotton Fibre," by Dr. F. M. L. Sheffield, which appeared in the October issue of your Review, Vol. XIII., No 4, the author writes, with reference to stomatal hairs (p. 284), that ". . . if then a hair were to grow through the stomatal cavity, we should expect to see a colourless cell on each side of the hair. This is not shown in Ayyar and Ayyangar's photographs, where all the epidermal cells are densely coloured. . . ."

I wish to draw the attention of Dr. Sheffield to the article "Differentiation of Hairs on the Seed Coat of Cotton"—II., published in the January issue of your Review, Vol. XI., No. 1, pp. 37-39, where the microphotographs Figs. 2 and 3 show, as expected, a colourless cell on each side of the hair.

I remain, Sir,
Yours truly,
G. S. Ayyangar.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

167. Report on the Work of the Indian Trade Commissioner during 1935-36. By Dr. D. B. Meek. Much useful information is given in the various sections of this report, dealing with modern trade tendencies; agricultural products, foodstuffs and industrial materials; Indian timbers; lac and shellac; Indian minerals; trade publicity; committees and conferences. Various appendices are also included. During the period under review Lancashire continued strenuously to encourage the use of Indian cotton by research and propaganda. There was a slight decline (less than 2 per cent.) in regard to imports of long staple cotton, but the imports of short staple cotton into England showed an increase over the previous year.

168. Lancashire Indian Cotton Committee. The third annual report of the Committee, issued on February 11, is the usual admirably printed and well-illustrated document. It is very satisfactory to record that the imports of Indian cotton into the United Kingdom reached a total of 546,654 bales, compared with 394,000 bales in 1935, and the fact that the takings have passed the " half-million bales " mark constitutes the most significant event of the period under review. Shipments since the end of the last cotton year also show improvement, thus demonstrating that the success of 1936 is no mere " flash-in-the-pan."

The Committee expressed warm appreciation of the help it received during the year from the President and officials of the Board of Trade, the Indian Central Cotton Committee, the British Cotton Industry Research Association, and from the spinners, manufacturers, and merchants, without whose co-operation such successful results could not have been achieved.

Propaganda work was actively maintained during the year, and for the third time in succession goods made from Indian cotton, including yarns of all kinds and a wide range of finished fabrics, were exhibited at the British Industries Fair held in London, and later were also exhibited in the display windows of India House. In addition arrangements were made for a permanent exhibition of Indian cotton goods to be housed in the Imperial Institute. The British Cotton Industry Research Association rendered valuable practical help in carrying out technical investigations and in making available for the second year the services of their principal liaison officer to discuss with manufacturers the possibility of extending the use of Indian cottons. Spinning tests on new strains of Indian cotton were carried out by the Association's staff at the Shirley Institute, and advice was given to spinners regarding various technical problems arising in the processing of Indian cottons, the result of which has stimulated the demand for a wide selection of varieties.

The following appendices are included in the report: Statistical tables and graphs; spinners using Indian cotton and yarns produced; manufacturers using Indian cotton; list of piecegoods, etc., made in Lancashire from Indian cotton; suppliers of Indian raw cotton, (*a*) in India, (*b*) in the United Kingdom.

The report is a useful and interesting document. Copies can be obtained free on application to the Secretary of the Committee, 333-350, The Royal Exchange, Manchester 2.

169. REPORT ON ECONOMIC AND COMMERCIAL CONDITIONS IN INDIA, 1935-36. By Sir Thos. Ainscough. (Issued by Dept. of Overseas Trade, 1936.) *Cotton Exports.* The propaganda work carried out by the Lancashire Indian Cotton Committee, with the active co-operation of all sections of the Lancashire cotton industry, to promote the greater use of Indian cotton in Lancashire, met with much success. In 1933-34 Indian cotton represented 8 per cent. of Lancashire's total consumption from all sources, whereas in the first ten months of 1935 the figure had risen to 17 per cent.

170. THE INDIAN COTTON SITUATION, 1929-35. (*Rpt. of Imp. Coun. Agr. Res.* From *Mnthly Bull. of Agr. Sci. and Practice,* xxvii., **11**, Rome, 1936.) The climatological and other environmental conditions under which cotton is grown in India are first dealt with. It may be mentioned that cotton sowing and picking are going on in almost every week of the year in some part or other of India, thus indicating the tremendous range in the sowing and picking periods obtaining in this country due to variations in the climate. The three main classes of soil suitable for cotton growing in India are then discussed, followed by sections dealing with breeding and genetics, methods of cultivation, and the various irrigation systems.

171. INDIAN COTTON: REVIEW OF THE 1935-36 SEASON. We have received from Messrs. Chunilal, Mehta and Co., Bombay, a copy of the *Indian Cotton Review for the* 1935-36 *Season.* The cotton crop for the season reached 5,728,000 bales, compared with 4,858,000 bales during 1934-35. The greatest production was in Oomras, Punjab-Americans, Broach, and Western-Northerns. The total exports amounted to 3,779,000 bales against 3,118,000 bales in the previous season. This is the largest export figure since 1928-29. The consumption of Indian cotton by the mills in India constituted a new record at 2,680,000 bales. A few new mills were erected, and the demand for indigenous cloth increased, but the prices obtained were not very satisfactory.

Prospects for 1936-37.—The growing crop escaped the drought of July and August, and if normal conditions continue a crop of 6,500,000 bales is expected.

The report contains tables of statistics dealing with the world supply, distribution, and stocks of Indian cotton, Indian cotton acreage and production, Bombay cotton prices, cotton exports, etc.

172. SUPPLY AND DISTRIBUTION OF THE VARIOUS TYPES OF INDIAN COTTON, SEASON 1934-35. (*Stat. Bull. No.* 5. Ind. Cent. Cott. Comm., 1936.) A useful pamphlet giving statistical and other information concerning: (*a*) Supply and distribution of the various types of Indian raw cotton held by the mills and the trade in India on August 31, 1934 and 1935; (*d*) Stocks of Tinnevellies, Salems, and Cambodias held in the Madras Presidency by the mills and the trade on January 31, 1935 and 1936; (*e*) receipts at mills in India of raw cotton classified by varieties; (*f*) exports by sea of Indian raw cotton classified by varieties.

173. SPINNING TEST REPORTS ON INDIAN COTTONS, 1935-36. By N. Ahmad. (*Tech. Circs. Nos.* 258-266, 1935-36. Ind. Cent. Cott. Comm.) The circulars contain the report of the Standards Committee and spinning test results for Bagalkote, Cambodia, Tinnevelly, Karunganni, Westerns Javaria, and Kumpta cottons for the 1935-36 season, and the report of the Special Appeal Committee on African cotton and spinning test results for Jinja, Busoga, and Kampala cottons for the 1935-36 season.

174. BOMBAY COTTON ANNUAL, 1935-36, No. 17. (East Ind. Cott. Asscn. Ltd., Bombay. Price Rs. 1-8-0.) The usual authoritative compendium of all matters relating to every branch of the cotton trade. Numerous statistical tables are included of crops, exports, imports, prices, stocks, consumption, Government notifications, etc. The book should meet the requirements of all who are interested in the production, distribution and consumption of Indian and foreign cottons, yarn and cloth.

175. SEA ISLAND COTTON CULTIVATION IN KANARA. By N. S. Rau. (*Ind. Text. J.*, **46**, 1936, p. 413. From *Summ. of Curr. Lit.*, xvi., **22**, 1936, p. 639.) Experiments with Sea Island cotton in South Kanara have given satisfactory results. Selection work has yielded strains of fine Sea Island cotton of a staple length ranging from 1¼ inches to nearly 2 inches, and with a wide range of difference in colour such as white, cream, white tinged with pink, or light brownish yellow. These different types are being purified as rapidly as possible. Superfine Sea Island cotton with a staple length of nearly 2¼ inches can also be successfully grown in Kanara, but would be costly to produce, and the ordinary Sea Island cotton is more than good enough to meet all practical requirements. The Madras Agricultural Department is also interesting itself in the possibilities of Sea Island cotton cultivation on the west coast of the Presidency, and has sown some experimental plots which are in charge of departmental demonstrators.

176. MYSORE: *Cotton Investigations*, 1934-35. (*Rpt. of Dpt. of Agr.*, 1935, recently received.) Investigation work was continued with a view to evolving cottons suitable for the various districts. Selections 69 and H.190 showed promise, but were not wilt-resistant, whereas the Jayawant cotton introduced from Bombay was little affected by it. The results of trials of cotton for the Irwin Canal tract indicated that two strains, M.A.11 and N.T. 38, were promising, with yields stated to be about 1,000 lb. seed cotton per acre. Red leaf blight caused injury to cotton during the season.

177. TIRUPPUR-CAMBODIA COTTON: CHARACTERISTICS. By K. Kusebauch. (*Textilber.*, **17**, 1936, p. 625. From *Summ. of Curr. Lit.*, xvi., **20**, 1936, p. 582.) This cotton, grown in South India, is a regular, strong and soft cotton of 26-28 mm. staple, yellowish in colour, and almost free from impurities. The results of determinations of staple length, hair width, distance between convolutions, and maturity are tabulated. In India this cotton is spun to 42's and 44's yarn with a breaking length of 8·5 km.

178. INDIAN SCIENCE ABSTRACTS. (Pubd. by National Inst. of Sciences of India, Calcutta. Price 7 rupees 8 annas per number. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 265.) A recent addition to the list of abstracting journals dealing with scientific papers published in India, and also papers published abroad on work done in India or based on Indian material. The various sections are headed: General, Mathematics, Physics, Chemistry, Engineering, Geology, Botany, Zoology and Physiology.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

179. The following reports have recently been received:
DEPT. OF SCIENTIFIC AND INDUSTRIAL RESEARCH: Rpt. for 1935-36.
SOUTH-EASTERN AGRICULTURAL COLLEGE, WYE: The Journal, January, 1937.
BRITISH GUIANA: Divisional Rpts. of Dpt. of Agr., 1935.
CEYLON: Ann. Rpt. of Dpt. of Agr., 1935.
FIJI: Ann. Bull. of Div. Rpts., 1935.
GOLD COAST: Rpt. of Dpt. of Agr., 1935-36.
KENYA: Ann. Rpt. of Dpt. of Agr., 1935, vol. ii.

South Africa: Ann. Rpt. of Dpt. of Agr., 1936. (Farmg. in S. Afr.)
" " Official Year Book, 1934-35.
Sudan: Ann. Rpt. of Dpt. of Agr. and Forests, 1935.
Uganda: Ann. Rpt. of Dpt. of Agr., 1935-36. Pt. II.

180. Progress Reports from Experiment Stations, 1935-36. (Pubd. by the Empire Cotton Growing Corporation, 1937. Price 2s. 6d. post free.) Progress reports are included summarizing the work carried out during the 1935-36 season at the Cotton Experiment Stations in Queensland, South Africa, Swaziland, Rhodesia, Sudan, Uganda, Tanganyika, Nyasaland, St. Vincent, and the Seed Farm in Nigeria. Reports from the stations in Northern and Southern Nigeria have again been included by courtesy of the Government of Nigeria.

The important breeding work with U.4 and its derivatives was continued, and other promising strains were also evolved. Useful work was also carried out in connection with rotation of crops, time of sowing, spacing, cultural, and fertilizer experiments, and in the control of pests and diseases. In regard to the last, it may be said that over a large part of Africa insect damage constitutes a limiting factor in cotton growing, and a considerable proportion of the reports, therefore, is appropriately devoted to a description of investigations on the possibility of controlling these pests and the diseases they bring in their train.

All who are concerned with the cultivation of cotton and similar crops will find much in these reports that will be of interest and value to them.

181. The Work of the Experiment Stations, Season 1935-36: An Explanatory Review. By W. Nowell. (Pubd. by the Empire Cotton Growing Corporation, 1937. Price 1s. 6d. post free.) A very useful review. In the introduction is given an account of the modern methods of handling the many problems that crop up, and the way in which one branch of work has continually to be fitted into others is brought out. The report itself gives a brief and easily readable account of the actual work carried out at the various experiment stations of the Corporation, and of the progress made.

182. Report of the Department of Scientific and Industrial Research, 1935-36. (Cmd. 5350. Pubd. H.M. Stat. Off., 1937. Price 3s. net.) The twenty-first report contains the reports of the Committee of Council and the Advisory Council, and a review of the work carried out under the supervision of the Boards and Committees of the Department, together with a section describing the work of Research Associations. A brief account is included of the research work carried out by the British Cotton Industry Research Association and of the progress made since the inception of the Association in 1919.

183. List of Agricultural Research Workers in the British Empire, 1936. (H.M. Stat. Off., 1936. Price 5s. net.) Contains the names and addresses of agricultural research workers as on June 30, 1936, with the branch of science in which each is specially interested. The book is divided into four parts: Part A gives details of the Bureaux organizations formed for the distribution of scientific information among research workers; Part B gives the names and addresses of research workers arranged under countries; Part C classifies them according to the subjects in which they are interested; Part D is an index.

184. Maintenance of Empire Cotton Supplies. By Sir William Himbury. (*Oldham Chron. Text. Trades Review*, 2/1/37.) An interesting review of the present position, calling attention to the great increase in production that has occurred in recent years, and which in 1935 reached some 700,000 bales. Cotton growing has played an important part in the economic development of those parts of the Empire where it has become established, and has resulted in much benefit to the growers. The increased spending power of the people has been of immense advantage to trade generally, and the duties collected on goods sold have helped to provide better administration, increased medical services, education, etc., for the general uplift of the people. A summary is given of the progress made in the chief Empire cotton-producing countries.

185. ASIA. CEYLON: *Cotton Cultivation,* 1934-36. (*Ann. Rpt. of Dpt. of Agr.,* 1935, recently received.) The re-establishment of the Wellawatta Spinning and Weaving Mills, and the fixing of a guaranteed price for all clean first-grade seed cotton produced locally, have caused greater interest to be taken in cotton in the Southern and Central Divisions, where most of the crop is grown. A larger acreage was planted in 1934-35, but reduced yields were obtained owing to adverse weather conditions and lack of adequate attention to the crop by malaria-stricken cultivators. The total production of cotton was about 124 bales. Increased quantities of seed were distributed in 1935-36, and since cultivators showed more interest in the crop, the yield is expected to be double that of the previous season. Small amounts of cotton are grown in the North-Western and South-Western Divisions and cultivation has been started in the Kekirawa range of the Northern Division. Notwithstanding the efforts of the Department of Agriculture to foster cotton cultivation in the villages, production is still somewhat insignificant, and will remain so until a permanent system of crop rotation is established for dry-zone agriculture, possibly by means of settlement schemes.

186. COTTON CULTIVATION AT MAHO. By E. J. Livera. (*Trop. Agriculturist,* lxxxvii., **4,** 1936, p. 245.) During the past five seasons cotton has only once been cultivated with some success. The low yields were attributed to unsuitable climatic conditions.

187. AFRICA. EAST AFRICAN COTTONS: STAPLE LENGTH. By D. F. Kapadia. (*Ind. Text. J.*, **46,** 1936, p. 406. From *Summ. of Curr. Lit.,* xvii., **22,** 1936, p. 653.) The minimum staple length of African cotton is understood by the trade as $1\frac{1}{16}$ inches, but according to the experimental tests carried out by the Technological Laboratory it is defined as equivalent to 1·03 to 1·04 inches. The results of an experimental determination of the complete fibre-length distribution of a trade sample of Kampala cotton are given, and the figures show that whilst the mean staple length is 1·005 inches, the super-mean value—*i.e.*, average length of all the fibres between the mean and the maximum lengths—is 1·134 inches, a value agreeing well with the staple-length value estimated by the grader. Extensive data show that what the trade understands by staple length agrees well with the statistical quantity super-mean and not the mode or mean. The author, therefore, deprecates the use of mean staple length for staple length and suggests that experimental determinations of the length property of cotton should be recorded by the super-mean and that median should be used instead of mean to define the exact nature of the fibre-length distribution.

188. GOLD COAST: *Cotton Cultivation,* 1935-36. (*Rpt. of Dpt. of Agr.,* 1935-36.) Little interest was taken in the crop, possibly owing to the poor prices which have prevailed. A total of 69 tons of seed cotton was exported over the French frontier, compared with 81 tons in the previous season. It is reported that many farmers are leaving the area where most cotton has hitherto been grown, and are taking part in the extension of cocoa growing in Northern Togoland.

189. KENYA COLONY: *Cotton Cultivation,* 1935-36. (*Ann. Rpt. of Dpt. of Agr.,* 1935, vol. ii.) In the Central Province some 16,000 acres were planted to cotton, including 4,000 acres planted to U.4 in Kitui District. Although natives are conservative in their ideas, and it will take time for cotton to become really established, it is the only crop suited to the lower zones of the Province, and will, therefore, eventually fill a most important place in the development of the reserves and in drawing people down from the thickly populated higher zones. In the Nyanza Province marked success attended the efforts of the Department to encourage cotton cultivation by natives, and 11,830 bales were produced, an increase of 61 per cent. over the previous season. In the Coast Province also the season was a good one, with improvement in quality as well as in quantity. The total yield was 3,617 bales, an increase of 130 per cent. over the previous season. Considerable injury to cotton in some districts was caused by stainers, American bollworm (*Heliothis obsoleta*), and jassid, and in a lesser degree by pink bollworm, mealy bug, and leaf-rolling caterpillar.

190. NIGERIA: *Cotton Cultivation*, 1935-37. (*Half-yearly Rpt. of Dpt. of Agr. to September* 30, 1936.) *Northern Provinces.*—The final figure for American cotton of 49,793 bales for the 1935-36 season was slightly less than that for 1934-35, which was a little disappointing but was entirely due to unfavourable weather conditions in Zaria and Southern Katsina. A satisfactory feature was the increased production in Sokoto Province, Northern Katsina, and the Niger Province. The price paid (in pence per lb. of seed cotton) was 1·1d. rising to 1·6d., compared with 1·1d. rising to 1·5d. the previous season.

The total quantity of seed distributed for the 1936-37 season constituted a record, being 147 tons more than the previous season. With favourable weather conditions the crop has made excellent progress, and a yield slightly greater than that of last year is expected. For the coming season 127 markets have been gazetted, an increase of nine over last year. These include five markets which are being opened for the first time in the Bauchi Province.

Southern Provinces.—The total purchases of Improved Ishan cotton in the 1935-36 season amounted to 8,132 bales, which constituted a record since this cotton was introduced. Owing to adverse weather conditions, it is not anticipated that the crop for 1936-37 will equal that of 1935-36.

191. NYASALAND: *Cotton Prospects*, 1936-37. (*Text. Wkly.*, 19/1/37.) A report from H.M. Eastern African Dependencies' Trade and Information Bureau states that in the North Nyasa district the second crop of the early planted cotton was severely attacked by red bollworm. Late-planted cotton has come on well, and a very fair average crop is anticipated, though damage by pests is reported. Natives in this area are showing much greater interest in cotton growing, and particularly in U.4 seed.

192. NOTES FROM THE COTTON STATION, GATOOMA, SOUTHERN RHODESIA, 1936. By A. H. McKinstry. (*Rhod. Agr. J.*, xxxiii., **11**, November, 1936, p. 802.) In a brief review of the 1935-36 season at Gatooma it is stated that the planting rains were about a month later than usual, and this, coupled with a drought of over two weeks immediately after the commencement of planting, gave a poor start to the cotton season. Seed from later plantings did not germinate until after January 10, after which date the rains were adequate and well distributed. Injury from American bollworm, Sudan bollworm and jassid was more serious than usual, and as the result of all these adverse factors the yield on bulk acreages at Gatooma was only about 300 lb. seed cotton per acre. On farms and from plots of cotton grown in the native reserves yields may be considered as satisfactory under the prevailing conditions; in a few instances yields of 500-600 lb. seed cotton per acre were obtained.

A short account is given of the habits of the more important insect pests of cotton, and suggestions for their control. Notes are also included in connection with seed, spacing, thinning, and farming practices generally, for the benefit of the newcomer to cotton in Southern Rhodesia.

193. SOUTH AFRICA: *Cotton Industry*, 1935-36. (*Ann. Rpt. of Dpt. of Agr. and Forestry*, 1935-36. From *Farmg. in S. Afr.*, xi., **129**, 1936, p. 525.) During the past few years there has been a revival in cotton cultivation. Not only is a greater area in the Lowveld planted to cotton, but its cultivation is also increasing along the Orange River, and in the Rustenburg district there is a movement afoot to devote more attention to this industry.

Unfavourable climatic conditions during October and November delayed planting activities from five to six weeks in many cases, and the harvest season, therefore, was late, and at the time of writing production figures for the season were not available. The quality of the cotton produced in the Union is considerably better than that produced some years ago, and the demand for South African cotton in the United Kingdom is quite good. Judging from trade reports, there is every reason to expect that a favourable price level will be maintained.

194. SUDAN: COTTON RESEARCH WORK, 1934-35. By T. Trought. (*Ann. Rpt. of Dpt. of Agr. and Forests, Sudan*, 1935, Pt. II., p. 97.) Weather conditions were normal, and the selection work was continued. Reselections from X1530A and X04729 gave good promise among the Egyptian strains and selections from 574A and 511B (originally derived from Uganda S.G.85) among the American strains. Some of the new hybrids from Trinidad showed vegetative uniformity and had unusually fine long lint. Work was continued with the production of blackarm-resistant types. Blackarm appeared on X1530A, and continued active until November. Leaf curl damage was not severe, but pink bollworm caused much injury, the attack being quite as serious as in the previous year.

195. COTTON GROWING IN THE SUDAN. By Barbara Benson. (*Text. Rec.*, liv., **645**, 1936, p. 24.) An interesting account of the three groups of cotton pickers (numbering in all over 100,000 men with their wives and families) who migrate annually into the Sudan for the cotton picking season. In the first group are the semi-nomad Arabs from the White Nile Province and from immediately around the Gezira, and these are by far the most numerous. Secondly, there are the Arabs and blacks from the other provinces in the Sudan, of which Darfur and Kordofan supply the greatest number. Lastly, there are the people who come from outside the Sudan border, and from places which are over the other side of the continent, as, for example, Nigeria.

196. EAST AFRICAN AGRICULTURAL RESEARCH STATION, AMANI, TANGANYIKA TERRITORY. (*Eighth Ann. Rpt.*, 1935-36.) Contains the usual reports of the Director, Plant Pathologist, Entomologist, Soil Chemist, Biochemist, Plant Physiologist, Geneticist, Systematic Botanist, Superintendent of Plantations and Secretary and Librarian. In July, 1935, the first number was issued of the *East African Agricultural Journal*, edited by the Director. An Agricultural Research Conference was held in February, 1936, at which suggestions were considered for the centralization of agricultural research in East Africa. Good progress was made in the development of the Kwamkoro Estate by means of a grant of £5,000 from the Colonial Development Fund, and the possibilities of cinchona, derris, and aleurites are being tried out on the estate.

197. UGANDA: *Cotton Industry*, 1935-36. (*Crown Colonist*, February, 1937, p. 82.) The buying season in the Eastern Province opened with the satisfactory price of Sh. 12 per 100 lb. for raw cotton. Best quality lint is quoted at 53½ cents. The crop is in excellent condition, and buying is brisk. Cotton-seed has reached the record price of Sh. 55 per ton, and at this figure some 150,000 tons will probably be exported. Owing to the large quantity to be moved, the railways have promised to provide " umbrella " shelter at stations and ports at the low figure of 25 cents per ton. This is greatly appreciated by the cotton industry.

198. *Cotton Reports*, 1935-36. (*Ann. Rpt. of Dpt. of Agr.*, 1935-36, Pt. II., recently received.) From the report of the Botanical Section we learn that weather conditions were generally abnormal, especially in the Western area. Very high yields were produced at Serere on the bulk increase plots, which gave an average yield of 863 lb. per acre over 40 acres with the U.4/4/2 derivative S.P.20. Another derivative of U.4/4/2—S.P.87—yielded well and will be increased as rapidly as possible. Further evidence was forthcoming of the yield superiority of the U.4/4/2 derivatives in the Eastern Province, but as yet the quality of these is not up to minimum requirements. As a considerable increase in yield would result from distribution of S P.20, very detailed reports were obtained from all sources regarding the demand and price to be expected for such a cotton. S.P.87, though still superior to S.P.20 in quality, was not as good in this respect as in the previous season. A selection from S.P.87—S.P.92—showed promise. The strain B.P.50, which promised so well at Bukalasa last season, proved very susceptible to wilt, and had to be abandoned. In spinning tests S.G.23/8 maintained its superiority, and it also appeared to suffer less from wilt than most other strains. A further promising U.4 strain—U.B.24/4—was isolated in the breeding plot at Bukalasa. S.G.29 showed signs of deterioration in the Eastern Province, but in West Nile and Bunyoro its quality appeared superior to Buganda Local, and it was classed as being the best of the Serere samples during the season.

The Entomological Section reports that a good beginning was made at Serere on a detailed study of the major cotton pests in the Eastern Province—viz., jassids, stainers, *Lygus* and *Helopeltis*. Satisfactory progress was also made in connection with the work on pink bollworm, which engaged the sole attention of one of the officers of the Section.

Studies on blackarm disease were continued by the Mycological Section, but the main interest centred around the serious cotton wilt position. This disease has increased both in distribution and severity during recent years, and the breeding of resistant strains would appear to be the simplest method of control.

199. *Cotton Prospects*, 1936-37. The latest report from the Dept. of Agriculture states that in most areas the dry period which occurred at the beginning of January was followed by rainfall above the average. In some areas damage has been caused to ripe bolls and harvesting has been held up, but in most districts the crop has benefited. The quality of the crop is reported to be good, and a yield of 330,000 bales is anticipated.

200. *Cotton Prospects*, 1936-37. A recent report from H.M. Eastern African Dependencies' Trade and Information Office is to the effect that the estimated acreage is 1,487,768 acres. This figure includes increases due to more accurate estimations in certain districts, particularly in Buganda Province, but it is nevertheless a satisfactory advance on last season's total of 1,365,529 acres.

As from January 1, 1937, the fee for a ginning licence will be uniform throughout the country at Shs. 1,000. An addition to the Cotton Rules provides that the District Commissioner may prohibit the storage of cotton in a building at a cotton market or ginnery if he considers such building to be unsuitable for the purpose.

201. AUSTRALASIA. QUEENSLAND: *Cotton Industry*, 1935-36. (*Queensland Agr. J.*, November, 1936, p. 673.) Production for the season amounted to 13,500 bales of 500 lb. This total, although somewhat lower than the previous season, is very satisfactory considering the adverse weather conditions experienced and the severe and unusual jassid attack in the Callide Valley.

For the 1936-37 crop sufficient seed had been issued up to October 22 to plant 52,000 acres, compared with 58,000 acres for the same period last season; it is anticipated, however, that with the advent of good rains the acreage planted to cotton will equal that of last year.

202. FIJI: *Cotton Cultivation,* 1934-36. (*Ann. Bull. of Div. Rpts.*, 1935, recently received.) The 1934-35 cotton season was a poor one owing to the unfavourable weather conditions experienced, and only 42,860 lb. of seed cotton were purchased, growers receiving an average of 2·4 pence per lb. for their crops. Twenty-four bales of Fiji Backcross and one bale of Sea Island lint were despatched to London for sale.

In the 1935-36 season efforts were made to stimulate interest in the cotton industry, and permission was obtained from Government to grow a crop of not more than 150 bales of Sea Island cotton (under the restriction scheme now in force in the British West Indies), and in addition it was anticipated that 150 bales of Backcross No. 172 would be produced. Should the season prove successful and satisfactory prices be obtained by the growers, it is expected that the area will be doubled in 1936-37.

203. WEST INDIES. WEST INDIAN SEA ISLAND COTTON ASSOCIATION. The Fourth Annual General Meeting of the Association was held in St. Kitts in November last. Among the important matters considered was the report of the Advisory Committee in England, the main activities of which fall under trade mark administration, research, and advertising. Efforts have been made to find new outlets for the consumption of Sea Island cotton, and it is hoped to arrange weekly broadcasts of Sea Island cotton market information from London through the British Broadcasting Corporation. In regard to the work undertaken by the Wool Industries Research Association, considerable progress is reported. The mixture yarn produced from 50 per cent. chlorinated wool and 50 per cent. Sea Island cotton has been shown to have twice the strength of an all-wool yarn, while retaining the appearance and feel of wool, and it is unshrinkable.

204. ANTIGUA: *Cotton Growers' Association.* (*Crown Colonist,* December, 1936, p. 559.) A recent Ordinance incorporates the Antigua Cotton Growers' Association, thus creating a corporate body capable of entering into binding contracts and association with the West Indian Sea Island Association to promote and protect the Sea Island cotton industry.

205. REPORT ON A VISIT TO MONTSERRAT. By F. A. Squire. (*Vincentian,* 21/11/36.) A report of a visit to study the cotton pest problem of the island. A critical examination of various estates indicated that some 30-40 per cent. of the cotton crop was attacked by pink bollworm, but in addition serious injury to the bolls was caused by external boll disease, and in all two-thirds of the crop was lost. The conditions responsible for attack by pest and disease were excessive rainfall and high humidity in the cotton fields. A change of planting date is suggested. All planting should be completed by December 1 to enable the crop to establish itself before the end of the rains, and bolling to take place in the dry months.

No indigenous parasites of pink bollworm were found in the island, and it is proposed that, after a suitable study of conditions, *Apanteles thurberiæ* be introduced with a view to the control of the pest. The need for more effective seed fumigation is stressed.

206. ST. VINCENT. *Cotton Prospects,* 1936-37. (*West Ind. Comm. Circ.*, li., **997,** 1936, p. 526.) Towards the end of October a great improvement was noticed in the general appearance of the crop, and it is estimated that production will exceed 1,000 bales. Angular leafspot has caused damage to leaves, flowers and bolls.

COTTON IN EGYPT.

207. Egypt. Review of the 1935-36 Cotton Season. (*Egyptian Cotton Year Book*, 1935-36, p. 13.) Conditions during the growing period were unfavourable; sowing was later than usual, and leaf worm attacks were heavy, causing damage in many districts, especially in Middle Egypt. During the maturity period, however, exceptionally favourable weather helped in finally producing one of the finest crops grown in the Delta. The staple of Sakel cotton was markedly better than in any previous years; whether this was due to the propagation of larger quantities of the selected Government Sakel seed known as Sakha 4, or to strict application of the Anti-Mixing Law, or whether, as in the case of Giza 7, climatic conditions during the maturing period contributed to perfect fibre development, it is not possible to say.

208. Source of Egypt's Wealth: The Romance of Cotton. By W. L. Balls. (*The Times*, Egyptian Number, 26/1/37.) An interesting article describing the work on the improvement of cottons that is always going on in Egypt, and which has resulted in the production of outstanding types such as Giza 7. The author concludes by saying that in Egypt "applied science has been such a paying investment that our equipment of today, spending £20,000 a year on the Botanical Section alone, where there had been one room, one tent, one acre, one lab. boy, and one botanist in 1905, will appear as primitive to the next generation. The crop of Giza 7 in the single year 1935 yielded sufficient extra money to the country to repay every piastre which had been spent on agricultural botany in Egypt since the Khedivial Agricultural Society started such work thirty-one years earlier."

209. A White Cotton for Egypt. By H. E. Fouad Bey Abaza. (*Int. Cott. Bull.*, xv., 57, 1936, p. 112.) This new cotton, which has been named Bahtim Abiad, originated from a cross between Maarad and Sakel made by the Royal Agricultural Society of Egypt some years ago, and after much selection work it is now considered good enough for commercial propagation. Bahtim Abiad is whiter than Sakel, Giza 7, Casuli or even Peruvian Tanguis, and resembles the old Egyptian Abassi. It yields well and has a staple length of $1\frac{7}{16}$ inches, the length, strength and fineness of the lint being similar to that of Giza 7. The reports of spinning tests are very encouraging. The price will be the same as that of Giza 7 or slightly lower.

210. The Egyptian Cotton Year Book, 1935-36. We have received from the Editor a copy of the fifth edition of this publication. It contains a review of the 1935-36 cotton season and prospects for 1936-37, and numerous tables of statistics of acreage, production, stocks, prices, consumption, exports, etc. In addition there are the following among other short articles: "The Tendering of Egyptian Cotton in Liverpool" (A. N. Boumphrey); "Breeding and Propagation of New Cotton Varieties in Egypt" (G. Pilavachi); "Latest Developments in Ginning and Steampressing in Egypt" (G. Pilavachi); "The Egyptian Cotton Section of the Lancashire Cotton Industry in the 1935-36 Season" (D. Windel); "The Yarn Strength of Egyptian Cottons" (H. A. Hancock); "Giza Varieties" (C. H. Brown); "Bahtim Abiad" (Fouad Bey Abaza).

211. Formation of Cotton Ginners' Association. (*Int. Cott. Bull.*, xv., 57, 1936, p. 119.) As the outcome of a resolution adopted by the Joint Egyptian Cotton Committee at its last meeting, urging the formation of an Association of Cotton Ginners in Egypt, the Department of Agriculture officials and the Alexandria cotton merchants state that such an organization has now come into being. The title of the Association is the Chambre de l'Industrie Egyptienne de l'Égrenage du Coton, and it will work under the auspices of the Egyptian Federation of Industries. The main objects are stated to be "the defence of the interests of the Egyptian cotton ginning industry, in harmony with the general economy of the country, and the study of all questions, direct or indirect, interesting that industry which are submitted to it by members, either by institutions or by Government departments."

212. Progress Report on the Spinning Test Station at Giza. By H. A. Hancock. (*Int. Cott. Bull.*, xv., 57, 1936, p. 95.) The Spinning Test Mill at Giza has now nearly completed its first full season, in the course of which over 500 samples have been subjected to spinning tests, apart from a number of "micro" spinning tests. In addition to the examination of the Plant Breeding Section's numerous collection of new cottons, two large-scale series of spinnings by the standard technique were undertaken during the year. These are the investigations of mixings of all the different varieties of Egyptian cotton—whether known to commerce or not—and the tabulation of yarn strength and staple characters of all the main commercial Egyptian cottons in two grades. Some light has been thrown on the quality of low-grade Sakels, about which spinners have been complaining for some years. There is a bigger difference in strength between F.G. and F.G.F. with Sakel than with any other variety, and the cause is probably due to damage by cotton-worm. Sakel is now definitely vanishing from the Egyptian market, since there are cottons which are from 5 to 10 per cent. stronger than the best Sakels ever grown in Egypt, grade for grade, and there is no reason to think that the trade will be unable to obtain the high-strength cotton to which they have been accustomed, with the passing out of the Sakel variety.

213. Giza Varieties. By C. H. Brown. (*Egyptian Cotton Year Book*, 1935-36.) A brief discussion of the selection work carried out by the Botanical Section at Giza.

214. Experiments in Egypt on the Interaction of Factors in Crop Growth. III. The Effects of Variety, Spacing, Nitrogen and Water Supply on the Development of the Cotton Plant and the Rate of its Absorption of Nitrogenous Fertilizer. By F. Crowther. (*Bull. No.* 25, Tech. Ser. Roy. Agr. Soc., Egypt, 1936.) Two cotton experiments were carried out at Bahtim and Gemmeiza in 1934. The principal observations comprised (*a*) records of heights and node-numbers on the main stem, rate of fruit production, and distribution of the potential and final crop along the main stem, and (*b*) dry-weights and nitrogen analyses of the leaves, stems, flower-buds and bolls, of samples of plants from all plots, made at intervals during the main period of growth. Rates of absorption of nitrogen from the soil by the plants, and of recovery of the nitrogen added in the fertilizer, were calculated from the latter data. It is shown that a variety's superiority in yield was not the result of greater height and node development of the main stem, nor of greater total dry matter production. With all varieties there was heavy shedding of the potential crop of the top part of the plants, and in consequence the lower nodes are mainly responsible for bearing the bolls picked at harvest. The cultivator should concentrate his attention on the requirements of this bottom crop. Wider spacing resulted in additional fruit development at all nodes of the main stem. The factor restricting fruit production in close spacing is probably excessive shading of the lower leaves. Nitrogenous manuring increased the crop in the upper part of the plant. It is suggested that the greater response of a variety to nitrogen depends primarily on the rate of fruit production. Plants of all varieties removed nitrogen from the soil most rapidly during June, and this shows the necessity of securing plants as large as possible by the beginning of June, and of applying nitrogenous manure early enough for it to be available from the beginning of the month. Heavier irrigation increased the height and node numbers of the main stem in both experiments, and the total amount of dry matter at Bahtim, but otherwise had little effect.

215. Experiments in Egypt on the Interaction of Factors in Crop Growth. IV. Nitrogenous and Phosphatic Manuring of Cotton and their Relation to Variety and Spacing. By F. Crowther *et al.* (*Bull. No.* 26, Tech. Ser. Roy. Agr. Soc. Egypt, 1936.) Describes six experiments undertaken by the Joint Research Scheme (Egypt) which have a bearing on the manuring of cotton. Five were situated in the Delta and one in Upper Egypt. The principal group consisted of four experiments, each comprising seventy-two treatments, where the factors of variety, spacing and nitrogen supply were combined with a fourth, which was in three cases phosphate, and in one case water supply. Two smaller experiments extended this study to the reclaimed land of the north Delta and to Upper Egypt. Nitrogen applications produced significant increases in yield in all experiments made in the Delta. The results emphasize the change in the requirements of the cotton crop in recent years consequent upon a shortening of the growing season, the introduction of new varieties, and the adoption of closer spacing. The difference in varietal response to nitrogenous manuring was the same as in 1935 and 1934, and the order of the varieties was the same. Spacing gave the same well-defined trend in all experiments, towards highest yields with the closest spacing employed, 15 cm. between holes. Phosphate application produced significant increases in yield in two of the five experiments in which phosphate was included. The varieties grown in these two experiments showed remarkable differences in their response to phosphate. Giza 7, without phosphate, was superior in yield to Maarad, with phosphate it was significantly inferior. The order of the varieties for response to phosphate was not the same as that for response to nitrogen, and was independent of the amount of nitrogen applied.

COTTON IN THE UNITED STATES.

216. The Present Position of American Cotton. By A. B. Cox. (*Int. Cott. Bull.*, xv., 57, 1936, p. 55.) The author writes that " for the first time in over 100 years the United States is experiencing the disadvantages of a cotton-producing country which does not have sufficient production to dominate world prices. When the United States produced close to 60 per cent. of the world's cotton, a short crop in this country was compensated for by a corresponding rise in price. Now that the United States is producing only about 40 per cent. of world cotton, a large part of that advantage has been lost, and cotton growers may now experience all the disadvantages of widely fluctuating income resulting from a short crop and a comparatively low price at the same time. This year (1936) the United States has had a sharp reduction in supply without a corresponding rise in price. . . . There are a number of reasons which may be offered in explanation of this . . . the fundamental ones are that foreign producers are now supplying more than enough cotton to make up for our reduced production, and because of our tariffs, most foreign buyers either prefer or are forced to buy raw cotton from our competitors."

217. Government Control of Cotton Production in the United States, 1933-35. By E. L. Day. (*U.S. Dpt. Agr., Bur. Agr. Econ., Agr. Econ. Bibliog.*, 63, 1936. From *Exp. Sta. Rec.*, 75, 2, 1936, p. 273.) Includes 326 annotated references selected from publications during the period 1933-35.

218. United States: *Yearbook of Agriculture*, 1936. (Price $1.25. From *Pl. Bre. Absts.*, vii., 2, 1937, p. 251.) The book differs considerably in form from preceding issues, being largely devoted to a " survey of superior germ plasm "

which occupies over 1,000 pages. The remainder of the book contains the Secretary's report and a selection of the annual statistics; the complete statistics are to be published separately. The survey of superior germ plasm is a most ambitious project, dealing with plant and animal breeding in the United States and abroad. Introductory chapters giving a popular and brief account of genetics and breeding are followed by chapters dealing with the crops and animals concerned; the crops are wheat, barley, oats, rice, maize, sorghum, sugar-cane, sugar-beet, cotton, flax, and tobacco. These chapters contain a wealth of material of interest to plant breeders, and are authoritative accounts by men who have first-hand experience of the respective crops.

219. Cotton Investigations in the U.S.A., 1936. By H. W. Barre. (*Rpt. of the Chief of Bur. of Plant Industry,* 1936.) An important development of the year in the growing of the Egyptian type of cotton in the south-west was the establishment in commercial production of the S × P variety, introduced experimentally by the Bureau some years ago. S × P is derived from a cross between Sakel and Pima cotton. In 1935 some 1,700 acres of the new variety were grown in the Salt River Valley, with such satisfactory results in yield and quality that the demand for planting seed in 1936 exceeded the supply. In 1936 about 10,000 acres were grown, an acreage that should be sufficient to test the market for this cotton in comparison with Pima. Sakel is imported in large quantities, and if S × P proves to be a satisfactory substitute, it will afford possibilities for expanding the domestic production of this type of cotton.

In response to a pressing need for earlier and more prolific strains of cotton of the Sea Island type better adapted to present conditions, for growing in the south-eastern states, special studies are being made of hybrids between Sea Island and superior long-stapled Upland varieties, to find a type combining the long, silky quality of Sea Island fibre with the larger bolls and earlier maturity of Upland. A selection out of the Tydewater variety of Upland cotton, developed by a former breeder of Sea Island in co-operation with the Bureau, gives promise of the desired qualities. It is much more productive than Sea Island, has a boll double the size, and produces fibre 1½ inches long and of fine quality. Improved strains of Meade cotton, another Upland long-staple variety, are also being developed for the hybridization work.

220. Sampling American Cotton. By S. W. Martin and F. Cleaves. (*Int. Cott. Bull.,* xv., **57**, 1936, p. 40.) Deals primarily with the question of sampling, but also discusses the questions of false-packed, plated, two-sided, and mixed-packed bales.

221. Single Variety Cotton Communities in U.S.A. By H. W. Barre. (*Rpt. of the Chief of Bur. of Plant Industry, U.S.A.,* 1936.) In 1935 more than 300 one-variety community developments had been established in 156 counties in eleven States, planting areas aggregating about 900,000 acres. It is estimated that 500,000 bales of improved community-grown cotton were produced in that season. The most notable progress was made in Georgia, Mississippi, and Texas.

222. Georgia: *Cotton Experiments,* 1935-36. (*48th Ann. Rpt. Exp. Sta. Ga.,* 1935-36.) Five strains of Stoneville No. 2, which had given high yields on the Station grounds, were planted in six other locations in the state for further trials. A large number of hybrids were made between varieties with contrasting characters for the purpose of determining the effect of different plant characters on yield. Selections were made from wilt-resistant hybrids in the F_2 generation, and a number of plants were found with a staple of about 1 inch; these are being tested for uniformity and wilt resistance. In experiments conducted at twelve different locations to determine the value of magnesium in cotton fertilizers, the application of 50 lb. of magnesium sulphate gave an increased yield at nine locations and a decrease at three. Where dolomitic limestone (which contains magnesium) was compared with calcic limestone as a filler in cotton fertilizer, a much larger increase was obtained from the former.

223. LOUISIANA: *Field Crops Experiments at the North Louisiana Substation.* (*N. La. Sta. Rpt.*, 1935. From *Exp. Sta. Rec.*, 75, **4**, 1936, p. 474.) Brief reports of experiments during several years with field crops include the following with cotton: Varietal, fertilizer, seedbed preparation, planting, and spacing tests, and comparisons of winter cover crops for cotton and corn.

224. OKLAHOMA: *Farmer-suggested Changes in Farm Organization, by Oklahoma Types-of-Farming Areas, for Purposes of Conserving Soil Fertility and Controlling Erosion.* (*Curr. Farm Econ.*, Ser. 49, ix., **6**, 1936.) A summary of data furnished by 5,346 farmers indicates that if Oklahoma farmers had complete control of their operations, and were financially able to carry out policies they believe to be best from the standpoint of maintaining fertility and controlling erosion, they would reduce the acreage of small grains and cotton in all major producing areas and for the state as a whole, while acreage of hay and feed crops would be increased as well as numbers of livestock.

225. TENNESSEE: *Cotton Varieties and Related Studies.* By N. I. Hancock. (*Bull. No.* 158, Agr. Exp. Sta. Tennessee, 1936.) An account of cotton varietal trials conducted by the Tennessee Experiment Station during the past seven years, and of studies of the several factors related to the yield and quality of the lint. The tests were carried out on 144 strains of various cottons, including Acala, Cleveland, Delfos, D.P.L., Express, Half-and-Half, Lone Star, Mexican Big Boll, Rowden, Stoneville, Triumph, and Trice cottons. Stoneville 2, the D.P.L. strains, and Delfos 719 showed all-round superiority, and have been recommended for cultivation.

COTTON IN FOREIGN COUNTRIES.

226. ARGENTINA: *Cotton Cultivation.* (*Text. Rec.*, liv., **644**, 1936, p. 65.) A plan for the expansion of the acreage under cotton during 1935-36 has been announced by the Argentine Ministry of Agriculture. In addition to the progress in the Chaco and the increase in population and in area devoted to cotton growing which is expected to take place as a result of the opening of the North Argentina Central Railway, attention will be given to overcoming obstacles which hamper cotton production in areas outside the Chaco. Various districts in Northern Argentina are suitable in soil and climate for cotton growing, but the chief barriers to expansion at present are lack of transport, of population, and of any knowledge of cotton cultivation among the farmers. It is planned to build roads in these areas, and to move farmers there from areas where wheat-growing has proved unprofitable.

227. COTTON CULTIVATION. The Junta Nacional del Algodon, Buenos Aires, is issuing illustrated folders giving information on how to prepare the land, how to plant the seed, the most injurious pests and diseases, and measures of control, etc., which should prove very useful to those with little experience in cotton growing.

228. LOS PRECIOS DEL ALGODON EN 1934 Y 1935. (*Bull. No.* 10, 1936. Min. de Agr., Buenos Aires, Argentina.) A detailed account of prices of cotton in Argentina, and a comparison with those of Liverpool.

229. L'ORGANISATION DE LA CULTURE COTONNIÈRE AU CONGO BELGE. By A. Ravet. (*Bull. Trimest. du Comm. Cotonn. Congolaise*, **2**, 1936, p. 3.) In this article the author compares the two systems, (*a*) free competition in free markets and (*b*) the system of cotton zones. Under (*a*) buyers had to be provided with a licence which showed that they had a suitable baling place within 2 km. capable of dealing with a purchase of 3,000 kilos of seed cotton. The minimum price was fixed by Government. The free markets now only operate in places where the cultivation is newly introduced. The cotton may be bought anywhere during the buying season (*e.g.*, December 1 to April 15), and it is no longer obligatory to have a ginnery.

Under (*b*), which is now operative in most of the country, the buyer has the sole right to buy within his own zone, and must have a ginnery of at least two 30-saw gins, and a press capable of baling at 300 kilos the cubic metre. He must also have a seed disinfector of approved design, and storage for the entire crop of the zone. The licence must be renewed annually. The gin owner must furnish seed free at the request of Government.

The individual cultivator is not, however, compelled to sell to the ginnery of his own zone, but may sell where he pleases. All the seed goes back to the land in its own district, which thus maintains a one-variety arrangement. Preparation is standardized. The native receives a guaranteed price, which does not vary during the season. The number of gins is restricted to those absolutely necessary, and this was a point of considerable importance in deciding the adoption of this system.

230. RAPPORT TECHNIQUE ANNUEL DE LA STATION DE SÉLECTION DE GANDAJIKA (BELGIAN CONGO) POUR LA CAMPAGNE 1935. By L. and D. Soyer. (*Bull. Agr. du Congo Belge*, xxvii., **2**, 1936, p. 193.) In the experimental work carried out with cotton U.4 gave an average yield of 688 kilos against 476 for its nearest competitor, Gandajika. The lowest in yield was Mebane. Samples sent to Europe gave U.4 as poorer in colour than Bambesa and Mebane, but of a higher market value.

Cotton at the station suffered little from pests and diseases, with the exception of damage by frisolée and from internal boll rots caused by *Nematospora*.

231. BRAZILIAN COTTON: PRODUCTION AND EXPORT IN 1936. By A. Schneider. (*Wirtschaftsdienst*, **21**, 1936, p. 1285. From *Summ. of Curr. Lit.*, xvi., **21**, 1936, p. 605.) A record production of cotton in Brazil in 1936 is reported. The states of Central Brazil have produced 1,300,000 bales compared with 638,000 bales in 1935. Pernambuco crop is estimated at 120,000 bales, and Sao Paulo 170,000 tons. The quality of the cotton has also improved. The export figures for 1936 show a great decline in exports to Germany, but increases in exports to Belgium, France, Holland, Poland, Finland and England. A great increase in exports to Japan is also indicated. Costs of production have been reduced, and good prices obtained for the cotton.

232. THE CHINESE COTTON CROP. (*N. China Daily News.* From *Int. Cott. Bull.*, xv., **57**, 1936, p. 28.) A brief outline of the progress of the cotton industry in China. In 1933 the Cotton Industry Commission was formed with the broad powers of applying State planning to an unorganized industry. The Commission's efforts have been largely concentrated on the improvement of cotton cultivation, which is the essential step before further reconstruction measures can be introduced. A longer staple variety of cotton is being produced, rendering China less dependent on foreign supplies, and the progress made to increase production, with a large exportable balance, is demonstrated by the record crop of eight million quintals anticipated this year. It is hoped that this record crop will bring prosperity to rural areas which have suffered a long period of distress.

233. CHINA: *Cotton Research*, 1935. (*Rpt. for* 1935, Nat. Agr. Res. Bureau, Nanking, China, 1936.) Work was carried on upon the environmental limitation of Chinese and American cotton varieties, also upon breeding improved strains suited to local conditions. A promising Chinese variety, "Changteh Naked-Seed," with a good yield, has been evolved and will be further tested. It has been found that American cottons often degenerate after being grown in China for some years, and produce green seed. This question is being studied with the view of discovering the cause.

234. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No.* 23, 1936 contains the following papers: "Un parasite de Ver Rose en arrêto l'offensive au Maroc" (G. Carle and J. Gatefosse)—an ichneumon, *Pimplaroborator*, is stated to parasitize pink bollworm in Morocco; "Le coton du Niger" (E. Charles-Pierre); "Le coton est en A.E.F. une source de richesse" (G. Boussenot). In the report of the Association for 1935 it is stated that after years of depression, cotton cultivation in the French colonies is once more forging ahead. *Bull. No.* 24 contains the following among other papers: "La culture du coton en Syrie en 1935" (M. Pignarre); "La culture du coton en Espagne" (E. M. du Bujanda). The usual notes on cotton in the French colonies and other countries, cotton legislation, marketing, etc., are included.

235. COTTON CULTIVATION IN FRENCH SUDAN. (*Fils et Tissus*, **24**, 1936, p. 605. From *Summ. of Curr. Lit.*, xvi., **22**, 1936, p. 639.) The production of the native type of cotton amounted to 2,000 tons in the 1935-36 season compared with 2,400 tons in 1934-35, whilst production of Budy cotton (hybrid Karungani-Garro Hills) increased from 150 tons to 250 tons. This cotton is increasing in favour with native growers. Yields of Allen cotton were disappointing owing to late rains and a severe locust attack. The production of Sakel in the 1935-36 season is estimated at 140 tons.

236. GREECE: *Cotton Industry.* (*Int. Cott. Bull.*, xv., **57**, 1936, p. 30.) The largest individual cotton cultivator in Greece is an English concern, the Lake Copais Company, Ltd., who are the owners of a fertile estate of about 50,000 acres formed by the drainage of the Copais Lake, situated in the province of Boeotia. Some 15,000 acres are planted to cotton, a part of which is cultivated by the Company, and the rest is farmed out to tenants. The Company have also introduced improved varieties of American cotton seed for propagation, and last year, at great expense, established the first model ginnery in the country.

237. JAPANESE COTTON INDUSTRY: COMPETITIVE POWER. By C. Lion. (*Bull. Soc. Ind.*, Rouen, **64**, 1936. From *Summ. of Curr. Lit.*, xvii., **23**, 1936, p. 701.) The low price of Japanese cotton goods is attributed to increases in efficiency and production, to low wages and to the depreciation of the yen. Conditions under which the workers live are discussed, and various reports are quoted. French and Japanese export figures are compared.

238. JAPANESE TEXTILE INDUSTRIES: PROSPECTS. (*Text. Wkly.*, **18**, 1936, p. 470. From *Summ. of Curr. Lit.*, xvii., **22**, 1936, p. 663.) Japanese textile import and export figures for 1929-35 are reproduced from a book on the present and future of Japanese trade and industry issued by the Mitsubishi Economic Research Bureau. The success of the Japanese cotton industry is said to be due to a great extent to its excellent mechanical equipment, which compares very favourably with the often inefficient machinery still in use in European countries. The author of the present article, however, considers that Japan is working on a false currency basis and will experience serious difficulties when a halt is called to Japanese inflation. Japan has added to her cotton spinning capacity by about 87 per cent. during the past five years. Her exports in quantity have been phenomenal, but when the values are reduced to British £-sterling or corrected to a gold standard basis the values of the cotton piece-goods exports

during this period are about £11,000,000 below those of 1925 and 1926. A graph showing exports of cotton piece-goods for both quantity and value from the United Kingdom and from Japan since 1924 is given.

239. MEXICO: *Cotton Industry*, 1935-36. (*Int. Cott. Bull.*, xv., **57**, 1936, p. 25.) The season promises to be the greatest in the history of Mexican cotton-growing. Up to mid-September 348,000 bales, weighing 230 kg. each, had been harvested. Coahuila and Durango States produced 176,087 of the harvested bales. It is estimated by the Department of Agriculture of Mexico that the area planted to cotton for the 1936-37 season will reach 300,000 hectares of 2·47 acres each. This would represent an increase of 63,000 hectares over the acreage of the previous season.

240. COTTON PRODUCTION. By P. K. Norris. (*U.S. Dpt. Agr., Bur. Agr. Econ., Foreign Agr. Serv.*, 1935. From *Exp. Sta. Rec.*, 75, **6**, 1936, p. 865.) Statistics covering a number of years on the acreage, production, and yields of cotton are included. The factors affecting the production in different cotton-growing districts are described, and the outlook for increased production is discussed.

241. PERSIA: *Cotton Expansion.* (*Text. Rec.*, liv., **645**, 1936, p. 68.) Reports from Persia state that the Government is undertaking several ambitious schemes of irrigation in order to increase areas suitable for cotton-growing, and is interested in importing tractors, gins and other cotton machinery. It is hoped that by developing the domestic cotton-growing industry cotton exports may be increased to assist in balancing Persia's foreign trade, and that a home supply of raw material may be available for the rising cotton-manufacturing industry.

242. PERU: *Cotton Production.* (*Text. Wkly.*, xviii., **454**, 1936, p. 556.) Cotton production in Peru in 1936 is estimated at 345,000 bales of 500 lb. compared with 370,000 bales for 1935. The quality of the crop is said to be below average owing to unfavourable weather conditions. It is expected that a larger acreage will be planted in 1937, as there is a tendency to plant cotton instead of sugar and rice. The demand for Peruvian cotton throughout the season was good, especially for the better grades.

243. ANTE-PROYECTO DE CREACION DE UN SERVICIO OFICIAL PARA EL ABASTECIMIENTO DE SEMILLAS MEJORADAS DE ALGODON TANGUIS. (*Bull. No.* 8, 1936. Min. de Fomento, Estacion Exp. Agr. de La Molina, Lima, Peru.) Preliminary proposals for the creation of a station for the supply of improved seed of Tanguis cotton. Descriptions of Tanguis-Canete and Tanguis-Productiva varieties are included.

244. SOVIET COTTON CROP: YIELD AND QUALITY. By M. A. Rotleider. (*M/c. Guar. Comm.*, 33, 1936, p. 476. From *J. Text. Inst.*, xxviii., **1**, 1937, A4.) The crop of 1,878,000 tons estimated in the U.S.S.R. Government plan was obtained a month ahead of time. The crop is much better in quality than last year, 90 per cent. being of selected and first sorts, and 70 per cent. is 29-30 mm. in length. This success is due to big capital investments made by the Government in cotton regions, to the extension of the acreage, and to the expenditure of large sums on irrigation, fertilizers, tractors, etc. Some pickers picked as much as 350 kg. a day; last year 120 kg. was considered excellent. The average yield was 1 metric ton per hectare.

SOILS AND MANURES.

245. SOIL-SAMPLING TUBES FOR SHALLOW DEPTHS. By F. Heyward. (*Soil Sci.*, 41, **5**, 1936. From *Exp. Sta. Rec.*, 75, **5**, 1936, p. 592.) Fully dimensioned working drawings, descriptions, and directions for use are given for three distinct types of sampling tubes designed at the U.S.D.A. Southern Forest Experiment

Station. The first device is a tube for collecting samples for moisture determination of the 0- to 7-inch soil depth, the second is a tube for collecting a large number of cores in undisturbed field condition from the 0- to 6-inch soil depth of a size large enough to grow tree seedlings, and the third is a tube for obtaining a large number of samples of constant volume from the 0- to 3-inch soil depth.

246. EROSION, PLANT GROWTH, AND SOIL VARIETIES. By J. C. Fick. (*Farmg. in S. Afr.*, xi., **128**, 1936, p. 464.) A discussion of erosion as exhibited in South Africa, with notes on measures of control.

247. RAINFALL, SOIL EROSION, AND RUN-OFF IN SOUTH AFRICA. By W. R. Thompson. (*Univ. Pretoria*, Ser. 1, No. 29, 1935. From *Exp. Sta. Rec.*, 75, **6**, 1936, p. 853.) This report briefly reviews the literature on erosion and run-off, and presents the results of an experiment which has been in operation for four years. The object is to test the amount of water lost through run-off and the amount of soil eroded from ten differently treated plats. The selected slope is 3·75 feet in 100 feet. Each plat is 6 feet wide and 90 feet long.

During the course of the experiment the loss of water and soil, respectively, was from 80 to 683 times greater from the uncultivated bare plat as compared with that from the veld intact plat. Avoidance of bare space is therefore fundamental to erosion control. Soil erosion and run-off are concomitant with the growing of cultivated crops. Maize and cowpeas grown for grain bear this out on a 3·75 per cent. slope. The cultivation of annual hay crops appears to be less detrimental. Teff grass prevents excessive erosion, but permits run-off, especially at planting time and during the establishment period. The shallow root system of this crop and the short period it occupies the soil seem to account for the comparatively high run-off. Rhodes grass, representing perennial planted grasses, was most effective in preventing run-off and soil erosion. Burning of surplus material (veld) annually increased bare space and encouraged run-off and soil erosion. The run-off was twenty-seven times greater than that of a veld plat intact during a good rainfall season, 1933-34. This was the most undesirable veld treatment from this aspect. Although close summer rotative grazing of veld with sheep increased run-off over and above veld left intact, it was less harmful than grazing and burning. Fallowing appears to be unsuccessful in preventing run-off and erosion. Kraal manure, when applied to maize, effected a considerable decrease in run-off. The importance and effect of organic matter in run-off control is indicated, and is being further investigated.

248. KENYA COLONY: *Use of Compost.* (*Ann. Rpt. of Dpt. of Agr.*, 1935, vol. ii., p. 104.) "During 1935, four pairs of 30 by 40 inch pits were excavated below and adjacent to the cattle shed. Mixed materials, left in the shed and thoroughly trampled for a week, produced a good sample of compost within three months. The addition of ammonium sulphate at the rate of approximately 2 lb. to each pit appeared greatly to increase bacterial action. Pits so treated, and when filled with suitable materials, attained initial temperatures ranging from 130° F. to 145° F. In all cases, however, these temperatures, instead of subsiding slowly, dropped rapidly after the first ten days, and at the end of sixteen to twenty days 80° F. to 90° F. only were the maxima. At the end of thirty to forty days the process seemed to come to a standstill, and yet the quality of the final material in crop results was good, though the material both in appearance and on analysis was incompletely decomposed."

249. UGANDA: *Use of Compost.* (*Ann. Rpt. of Dpt. of Agr.*, 1935-36, Pt. II.) Work on compost making has been started at Serere and Bukalasa, and at the former station one ton per day is being turned out at a cost of about four shillings per ton. The compost does help to keep the land in good heart, but on analysis it compares very unfavourably with figures issued from Indore. Up to the present no special leguminous crops have been grown for mixing with the normal bedding of the cattle, and *Imperata cylindrica* was used at Serere and *Pennisetum purpureum* at Bukalasa. A crop of sunn hemp is now being grown to mix with the other farm wastes in an attempt to bring the final compost up to standard.

250. KRAAL MANURE: A SIMPLE METHOD OF INCREASING THE SUPPLY. By S. D. Timson. (*Rhod. Agr. J.*, xxxiii., **11**, 1936, p. 838.) The method consists of the growing of sunn hemp, and cutting and placing in the cattle kraals the top growth when the crop has reached the full flowering stage.

251. VILLAGE WASTE. By R. Cecil Wood. (*Emp. J. of Exp. Agr.*, iv., **16**, 1936, p. 357.) An interesting account of experiments in Indore-composting carried out in Trinidad, showing it to be feasible but not economic. The high proportion of inert and often objectionable material increases the cost of manufacture and reduces the quality of the finished product. Evidence is given that the system outlined satisfies sanitary requirements.

CULTIVATION, IRRIGATION, GINNING, ETC.

252. THE EVOLUTION OF THE FIELD EXPERIMENT. By J. Wishart. (*Pl. Bre. Absts.*, vii., **2**, 1937, p. 172.) A paper read at the Plant Breeding Conference, Nanking, China, 1934. A concise account is given of the application of the principles of replication and randomizations to field experiments, leading to the randomized block and Latin square methods.

253. NON-REPLICATED FACTORIAL EXPERIMENTS. By E. A. Cornish. (*J. Aust. Inst. Agr. Sci.*, **2**, 1936, p. 79. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 133.) An example is given in which the working out of an agricultural experiment of complex factorial design without replication is made possible by utilizing the high-order interactions to furnish an estimate of the experimental error. A check on the suitability of the method is furnished by comparing the results with those obtained from a second replication of the treatments.

254. STATISTICAL METHODS AND THEIR APPLICATION TO AGRONOMY: A BIBLIOGRAPHY. By K. K. Guha Roy and P. C. Mahalanobis. (*Misc. Bull. Imp. Coun. Agr. Res.*, No. 9, Delhi, 1936. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 129.) A classified list of books and articles on statistics in relation to agriculture and biology.

255. SOME PRINCIPLES OF STATISTICS AND THEIR APPLICATION TO AGRICULTURAL EXPERIMENTS—II., III. (*J. Aust. Inst. Agr. Sci.*, **2**, 1936, pp. 67 and 109. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 129.) In Part II. an account is given of the normal distribution, "Student's" *t*-test and Fisher's analysis of variance. Part III. deals with the fitting of regression lines and calculation of regression and correlation coefficients, with tests of their significance. The use of the analysis of co-variance to increase the precision of an experiment is illustrated by an example.

256. THE PROBLEM OF COMPARING THE RESULTS OF TWO EXPERIMENTS WITH UNEQUAL ERRORS. By F. H. Smith. (*J. Coun. Sci. Indus. Res. Aust.*, **9**, 1936, p. 211. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 129.) Combination of two experiments in a single analysis of variance with a pooled estimate of error is not permissible when the experimental errors are not approximately equal. The author suggests how a comparison of treatment and error variance can be made in such a case, and shows that while the correct test, the method of approach to which has been indicated by Fisher, would require elaborate tables, a sufficiently good approximation may be had by means of Fisher's *z*-test.

257. DOES CULTIVATION CONSERVE SOIL MOISTURE ? By D. J. Esselen. (*Farmg. in S. Afr.*, January, 1937, p. 6.) The results of an experiment comparing

the rates of water lost from a sandy soil under four treatments—viz., soil mulch, straw mulch, non-mulch, and supporting a stand of weeds, are presented. The conclusions reached are in agreement with the results of experiments in other countries, and are to the effect that: (*a*) The rate of moisture loss from a bare soil is the same for all practical purposes, whether it is mulched or not; (*b*) the rate of moisture loss from a similar soil supporting a growth of plants is accelerated markedly; (*c*) a fresh-straw mulch causes only a small reduction in the rate of water loss as compared with an uncovered surface (this point requires further investigation); (*d*) the rate of moisture loss decreases with depth, more than half of the total lost by the top 3 feet coming from the 0- to 6-inch layer in 1934 and the 0- to 12-inch layer in 1935; (*e*) the rate of moisture loss through evaporation from the top foot is exceedingly rapid during the first 10-14 days after irrigation. For the soil mulch to be effective in reducing evaporation, it would have to be formed while the soil is too wet to be cultivated without seriously impairing its structure; (*f*) cultivation does conserve soil moisture, not because it forms a soil mulch, but because it controls plant growth.

258. PRELIMINARY STUDIES ON THE EFFECT OF DELINTING OF COTTON SEED WITH SULPHURIC ACID ON GERMINATION AND YIELD. By A. Hamid and N. Mohammad. (*Agr. and Livestock in India*, vi., **5**, 1936, p. 653.) Experiments with cotton in the Punjab demonstrated the value of the treatment.

259. THE EFFECT OF VARIETY, PLANTING DATE, SPACING, AND SEED TREATMENT ON COTTON YIELDS AND STANDS. By G. A. Hale. (*J. Amer. Soc. Agron.*, 28, **5**, 1936, p. 365. From *Exp. Sta. Rec.*, 75, **6**, 1936, p. 770.) The average results (1930-34) of a multiple-factor field experiment at the Georgia Experiment Station, including five cotton varieties and several planting dates and spacings and a seed treatment, are reported. This type of experiment was found to have a number of advantages over the common single variable field experiments.

Half-and-Half and Stoneville 2 led in yields when all planting dates were averaged. The early (late March) planting and the medium (late April) planting produced the same five-year average annual yields of lint, while the late (late May) cotton yielded only about one-half as much lint. Stands were poorest on the earlier planted cotton and thickest in May plantings.

When Stoneville 2 was grown, 1932-34, in 3·5-feet rows, unthinned in 1-foot and 3-foot hills, and thinned to two plants in hills 1 foot apart, the last spacing produced the highest yields, except for the medium planting date, when unthinned cotton in 1-foot hills equalled thinned cotton spaced 1 foot apart. The unthinned cotton was relatively poorer when planted late than for the other dates. Number of hills or the distribution of the plants rather than the total plants per acre is most important in spacing experiments. Planting date may affect the ratings of different spacings in cotton spacing experiments.

Where the cotton was planted early, although stands were somewhat irregular in some seasons, there was no significant correlation between acre yield and the total plants per acre, and only a slightly significant correlation between yield and number of hills per acre. Similar results were obtained for late-planted cotton with good stands every year. The medium planting showed a highly significant, positive correlation between lint yield and both number of plants and hills per acre. The number of hills on the variety plats, like those on the spacing plats, were correlated more closely and positively with the pounds of lint cotton produced than with the number of plants per acre.

260. QUELQUES DONNÉES SUR L'EXPÉRIMENTATION COTONNIÈRE: INFLUENCE DE LA DATE DES SEMIS SUR LE RENDEMENT. By R. Pittery. (*Ser. Tech. No.* 8, 1936. Inst. Nat. pour l'Etude Agr. du Congo Belge.) The first section deals with experiments carried out to determine the influence of time of planting on the yield of Wonder Dixie Triumph cotton at Dingila, Belgian Congo, in 1933-34. Nine weekly sowings were made from June 24 to August 19, the rainfall decreasing from a total of 1,071 m. for the first sowing to 862 for the last, the rainy days from 95 to 75. The average number of flowers per plant decreased from 35 to 9, and the mean yield similarly fell from 17 to 3 per plot. The results indicate that the best yields are obtained from early sowing. The second section of the book is occupied with experiments on twenty-three different varieties. A long series of tables is given, showing for each, with different dates of sowing, the number of flowers per plant, number of bolls collected, shedding index, production, lint index, length of fibre, and other features. The varieties studied included U.4, Kivu, Lightning Express, S.G.23/8, 27 and 29, Farm Relief, Super Cleveland, Acala, Dixie Triumph, Wonder Dixie Triumph, Lone Star, and several strains of the Bambesa Station.

261. MIXED FARMING IN EAST AFRICA. (*E. Afr. Agr. J.*, vol. i., **5**; vol. ii., **1** and **3**, 1936.) I. " Grassland and Arable Dairying in Certain Parts of Kenya," (R. S. Ball). II. " Grassland and Arable Dairying in the Trans-Nzoia District, Kenya " (C. Maher). III. " Starting a Dairy Herd in Kenya " (J. F. Lipscomb).

262. DOUBLE COTTON GIN. Platt Bros. and Co., Ltd. and I. Leech. (E.P. 453,715 of 29/4/35, 17/9/36. From *J. Text. Inst.*, xxvii., **12**, 1936, A602.) A double cotton gin of the type comprising two interconnected single action Macarthy gins is provided with an oscillating beater device carrying two flexible moving knives and characterized by the feature that such knives are supported at their ends by common rigid members, and are further supported at intermediate points by support rods or stays which can be adjusted as to length to flex the flexible knives for the purpose of adjusting them to the ginning rollers and compensating for uneven wear in the latter. A further feature consists of an improved arrangement of actuating mechanism for the pusher boards, comprising links attached to the pusher boards and also to levers fixed on a rocking shaft which is adapted to be rocked by a fork device actuated by eccentric or cam mechanism in timed relation to the movement of the movable knives.

263. VOLKART DOUBLE ROLLER GIN. By F. Vock. (*Ind. Text. J.*, **46**, 1936, p. 383. From *J. Text. Inst.*, xxvii., **11**, 1936, A518.) This patent double roller gin is illustrated and its outstanding features are listed. It has been constructed for use in any part of India irrespective of whether double or single roller gins are generally used. The gin requires 2·5 to 3·5 h.p. under average working conditions, and yields 100 lb. of ginned cotton per hour. Some advantages of the double roller over the single roller gin are enumerated.

264. IMPROVED METHOD OF GINNING LONG-STAPLE COTTON. By H. W. Barre. (*Rpt. of the Chief of Bur. of Plant Industry, U.S.A.*, 1936.) Because of complaints by manufacturers of the ginning of Pima cotton, experiments were conducted in 1935-36 by the Bureau of Plant Industry and the Bureaux of Agricultural Engineering and Agricultural Economics, to improve the methods of ginning this extra long-staple cotton on the roller gin. The most important features of the new method are the substitution of a " doffer " of galvanized iron for the brush ordinarily used to remove the lint from the roller, and the use of a suction condenser for conveying the lint through a flue to the press, instead of the present method of pushing it along the floor by hand with a brush. This method obviates the objectionable twisting and knotting, keeps the lint straighter and smoother, and improves the grade of the cotton.

265. THE EFFECT OF RAISING THE MIDDLE ROLLER AND SOME OTHER FACTORS ON THE YARN STRENGTH OF SINDHI COTTON. By N. Ahmad. (*Tech. Bull. Ser. A.*, No. 34. Ind. Cent. Cott. Comm., 1936.) Gives the results of experiments carried out to test the effect on the yarn strength of sixteen samples of Sindhi cotton of (i.) raising the middle roller from $\frac{1}{32}$ to $\frac{2}{32}$ inch; (ii.) of using middle top rollers of different weights varying from 5 to 2 oz.; (iii.) of using ordinary or the heavy back roller.

266. Mechanical Pickers. By D. M. Dow. (Received from the Dept. of Overseas Trade, 1937.) The author of this paper is Official Secretary for Australia in the United States. A tour in the cotton states of Tennessee, Mississippi, and Arkansas made it clear to him how desirable a good cotton picker is, to relieve the workers of great labour under a broiling sun. In Australia it would go far to solve the labour problem.

The machines studied were made by the International Harvester Company and by Messrs. Rust Bros. Both will pick cotton well, but it has yet to be found out whether they will do it satisfactorily under all the extremely varied conditions that occur in this cultivation. Mr. Dow saw the machines at work, and quotes the opinions in favour and against of a number of people whom he interviewed on the subject.

COTTONSEED AND OIL.

267. Uses of Cottonseed. (*Indus. and Eng. Chem.*, xiv., **17**, 1936, p. **345**. From *Trop. Agr.*, xiii., **12**, 1936, p. 314.) For some time oil has been extracted from cottonseed, but the procedures used have, as a rule, been expensive, because of the cost of apparatus, motive power, manual labour, and particularly upkeep. A simpler and more economical method of extracting the oil has been devised in the Congo. The seeds are ground coarsely as they come from the gin. The ground material is passed through a sieve to separate the kernels from the husks. The latter can be used as a second-grade fertilizer or can be made into fuel bricks.

The kernels are reground, and the cottonseed meal which is obtained is moistened and heated. The substance is placed in baskets pierced with holes, and is compressed under hydraulic presses of the same type as those used in baling the ginned cotton. The cottonseed oil is collected and the cottonseed cakes which remain constitute an excellent cattle food. The cakes can also be used as fuel.

The weight of extracted oil represents from 10 to 15 per cent. of the weight of the seed. The cost of production is about 50 centimes per kilogramme. The process is also significant from the standpoint of apparatus, since it requires only the equipment already used in the cotton industry. The cottonseed oil thus obtained can be used at once in fixed Diesel engines, as well as in automotive vehicles, for it is not necessary for the oil to be refined.

268. Estudio Economico de la Producción y Consumo de Aceites Comestibles (Edible Oils) en la Argentina. By C. Garcia Mata. (*Min. de Agr.*, 1936, Buenos Aires, Argentina.) The production of cottonseed oil has risen from 870 tons in 1923 to 15,770 tons in 1935, and the percentage from 5·3 to 29·8 per cent., while importation has ceased. The yield of cotton per acre in Argentina is said to be about 40 per cent. above the world average, an important fact in relation to oil supply.

269. Vegetable Oils and Oilseeds. (*Imp. Econ. Comm. London*, 1936. Pubd. H.M. Sta. Off. Price 2s. 6d. net, 2s. 9d. post free.) A summary of figures of acreage, production, exports, imports, and prices relating to cottonseed, linseed, rapeseed, sesame seed, soya beans, ground nuts, copra, palm kernels, palm oil, and olive oil.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

270. Insects in Relation to Plant Diseases. By J. G. Leach. (*Bot. Rev.*, i., **11**, 1935, p. 448. From *Exp. Sta. Rec.*, 75, **5**, 1936, p. 637.) This critical review from the Minnesota Experiment Station discusses the varied relationships of insects and plant diseases, insects in relation to virus and to non-parasitic diseases, the biologic and evolutionary significance of the association of insects and plant pathogens, symbiosis between insects and micro-organisms and its significance in plant pathology, the possible rôle of insects in the origin of new plant diseases and in the extension of old ones, and the future development of research in the field of insects in relation to plant diseases. The literature list includes 79 entries.

271. ADDITIONAL NOTES ON LITTLE-KNOWN COTTON INSECTS. By J. W. Folsom. (*J. Econ. Ent.*, December, 1936, p. 1066.) A continuation of studies carried out at Tallulah, Louisiana. Some nineteen species of *Coleoptera* are mentioned, the collective damage of which is of some importance. Control is effected by dusting with calcium arsenate.

[*Cf. Abstr.* **618**, Vol. XIII. of this Review.]

272. PROTECTION OF COTTON FROM DISEASES AND PESTS. (In Russian.) (*Sotzial. Nauka Tekhn.*, iv., **2**, Tashkent, 1936. From *Rev. App. Ent.*, **xxiv.**, Ser. A, **12**, 1936, p. 748.) Very brief notes are given on work carried out by the Central Asiatic Institute of Plant Protection in 1935. Sodium fluosilicate was almost as effective as calcium arsenate as a dust against the bollworm (? *Heliothis armigera*, Hb.), and did not injure the cotton plants. Measures against the red spider (*Tetranychus*) on weeds reduced the infestation of cotton and increased the yield.

273. DEVELOPMENT OF THE SYSTEMATIC CONTROL OF COTTON PESTS AND DISEASES IN OLD-ESTABLISHED COTTON-GROWING DISTRICTS. (In Russian.) (*Summ. Sci. Res. Wk. Inst. Pl. Prot.*, Leningrad, 1935, pp. 217-248. From *Rev. App. Mycol.*, xv., **12**, 1936, p. 799.) Most of the papers included in the section of this report dealing with the control of cotton diseases, give details of investigations in 1935 of the physiology of cotton wilt, which, in south-east Russia and in Central Asia is stated to be chiefly caused by *Verticillium dahliæ*. A. S. Letoff found that the microsclerotia of *V. dahliæ* germinated most abundantly (90-100 per cent.) in saccharose solutions with osmotic pressures between 7 and 10 atmospheres (0·3 to 0·4 mols saccharose), and that the osmotic pressure of the cell sap in the collar of native cotton varieties (*Gossypium herbaceum*) is of the same order at the stage of growth (flowering) when they are most susceptible to *V. dahliæ* attack, while that of the cell sap of the highly resistant, if not immune, Egyptian cottons is markedly higher. He suggests the possibility of raising the resistance of susceptible varieties by the application of adequate mineral fertilizers, a suggestion based on the facts that cotton plants growing in soils with high (common) salt content have a cell sap with higher osmotic pressure than normal, and that such plants were never seen to be attacked by the fungus. Preliminary tests indicate that the osmotic pressure of other host plants of the fungus lies within the range of the osmotic pressure at which the microsclerotia germinate freely, while that of species immune from it (monocotyledons) is invariably considerably higher.

In experiments recorded by Mme. A. M. Eremeyeva it was found that under favourable environmental conditions and in the presence of sufficient inoculum cotton plants are liable to infection by germinating microsclerotia of *V. dahliæ* in the soil from the time when the stems begin to become lignified to the end of the vegetation period. Under the peculiar weather conditions of 1935, which favoured a profuse but etiolated growth of the cotton plant, infection of the basal parts, revealed by the dark discoloration of the vascular tissues, was not reflected in the aerial organs, which showed no wilting. Such latently infected plants constitute a serious danger from the standpoint of the perpetuation of soil infection with *V. dahliæ*.

According to Mme. V. A. Yablokova, it was experimentally shown that both susceptible (native and American Upland) and resistant (Egyptian) cottons can be infected with *V. dahliæ* through wounds at the cotyledonary first leaf stage, but that such early infections do not usually spread to any considerable extent in the host tissues, only traces of vascular discoloration being found later in both the susceptible and resistant hosts. At the flower bud formation stage infection of the susceptible varieties resulted in a widespread invasion of the host vessels both longitudinally and radially, the mycelium penetrating the vascular system of the leaves. A preliminary series of tests showed that spores of *Fusarium buharicum* sprayed on cotton seedlings only penetrated the unwounded host cortex at the collar, from which the mycelium then spread to the pith.

274. INSECTS INFESTING COTTONSEED. By T. L. Bissell. (*J. Econ. Ent.*, xxix., 3, 1936, p. 634.) Four species of live insects were recently found in stored cottonseed in Georgia: *Carpophilus dimidiatus* Fab., *Læmophlœus minutus* Oliv., *Tribolium ferrugineum* Fab., and *Pyroderces rileyi* Wlsm. The first species was found in the larval and adult stages, the second and third in the adult, and the last in larval stages only. *Pyroderces rileyi* (Pink corn, or pink scavenger worm) and *Tribolium* occurred in the screenings from cottonseed, but caused no injury. *Carpophilus dimidiatus*, *Læmophlœus* and *Tribolium* were seen in cottonseed that had been stored for one, or possibly two, years, and of which 1·9 per cent. had been infested. *C. dimidiatus* was the most common, but it is not certain whether it was the first insect to attack the seed. Usually the whole kernels of the injured seeds were reduced to frass of a bright yellow colour.

275. TESTS AGAINST COTTON PESTS OF SOME PLANTS THAT PRODUCE ESSENTIAL OILS. By S. R. Kayumov. (In Russian.) (*Sotzial. Nauka Tekhn.*, iv., 1, Tashkent, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, 12, 1936, p. 748.) A detailed account of investigations carried out at Tashkent in 1935. Oils of *Ocimum basilicum, Satureia hortensis, Dracocephalum moldavica, Mentha sylvestris, Pelargonium roseum* and *Salvia sclarea* were applied as sprays in concentrations varying from 0·5 to 2 per cent. on cotton plants infested with *Tetranychus telarius*, L. or *Aphis gossypii*, Glov. The oil of *O. basilicum* gave irregular results, but the toxicity of all the other oils increased with the concentration in the spray. At 0·5 per cent. oil of *P. roseum* was the most effective against *T. telarius*, killing 38·5 per cent.; at 2 per cent. the highest kill, averaging 70·5 per cent., was obtained with oil of *S. sclarea*. This oil was not tested on *A. gossypii*, and the highest rate of mortality, averaging 50 per cent., was obtained with that of *P. roseum* at 2 per cent. On the whole the relative toxicity of the oils was the same for both pests. Further tests with *A. gossypii* showed that the oils also had a repellent action.

276. PLAGAS DEL ALGODONERO EN LA CAMPAÑA AGRICOLA, 1935-36. By J. Wille. (*Bull. No.* 35, 1936. Min. de Fomento, Estacion Exp. Agr. de la Molina, Lima, Peru.) A list of the chief pests attacking cotton in Peru, including *Gasterocercodes gossypii, Mescinia peruella, Heliothis virescens, Aphis gossypii, Alabama argillacea, Dysdercus ruficollis*, and *Anthonomus vestitus*. Notes are given on their life-history and the best methods of control.

277. A PRELIMINARY LIST OF INSECT PESTS AND THEIR HOST PLANTS IN SIAM. By S. Beller and P. Bhenchitr. (*Tech. Bull. No.* 1. Dpt. of Agr. and Fisheries Bangkok, Siam, 1936.) Includes (1) a list of insects arranged according to order, and family, and their hosts; (2) a list of host plants arranged by family, with the pests attacking them, and the nature of the injury. Twenty pests of cotton are mentioned, including *Aphis gossypii, Platyedra gossypiella, Earias fabia, E. insulana, Oxycarenus lætus*, and *Dysdercus cingulatus*.

278. SUDAN: *Cotton Pests*, 1934-35. By H. W. Bedford. (*Ann. Rpt. of Dpt. of Agr. and Forests, Sudan*, 1935, Pt. II., p. 63.) The pink bollworm was again important in most districts, but Egyptian and American bollworms were less prevalent than usual, and injury from Sudan bollworm was practically negligible. Under favourable conditions of heavy rains and consequent abundant weed growth, white flies started breeding early, and the cotton became heavily infested. Much trouble was caused on the Gezira Research Farm by a local but intense attack of white ants, which, by killing off large numbers of young plants, rendered the results from certain experimental plots valueless. Some success has been obtained with control measures. Other pests encountered included thrips, jassid, stainers, flea beetle, leaf roller, and stemborer, but these, on the whole, were light in their incidence on the cotton crop.

279. ANNOTATED LIST OF INSECTS INJURIOUS TO COTTON IN TANGANYIKA. By W. V. Harris. (Reprinted from *Bull. of Ent. Res.*, xxvii., 3, 1936.) The pests are grouped according to the part of the plant chiefly attacked by them. Within each group they are arranged in the usual systematic order. The major pests include the following: *Microtermes* sp., *Apion xanthostylum*, injurious to stems and branches; *Empoasca facialis*, *Prodenia litura*, injurious to the leaves; *Callidea bohemani*, *Dysdercus cardinalis*, *D. fasciatus*, *Platyedra gossypiella*, *Earias insulana*, and *E. citrina*, injurious to green bolls.

280. SOUTH CAROLINA: *Cotton Pests*. (*S. Car. Exp. Sta. Rpt.*, 1934-35. From *Rev. App. Ent.*, xxiv., Ser. A, 12, 1936, p. 805.) It is reported by J. G. Watts that although *Frankliniella fusca*, Hinds, was more numerous on cotton than in some previous years, *F. tritici*, Fitch, was the most abundant thrips. The peak of the population of *Psallus seriatus*, Reut. came late in August. Infestation in 1935 was slight. *Empoasca fabæ*, Harr. was plentiful on cotton in late June and July, but caused slight injury. Cage tests showed a slow leaf malformation, and a similar effect was produced by *Graphocephala versuta*, Say. In investigations on *Aphis gossypii*, Glov. it was found that *Lysiphlebus* (*Aphidus*) *testaceipes*, Cress. parasitized more than 75 per cent. three weeks after the aphids became significant on cotton at the college farm. The Pteromalid, *Pachyneuron siphonophoræ*, Ashm. was also parasitic on this aphid, and *Hippodamia convergens*, Guer. and *Chrysops* spp. were important predators.

281. PINK BOLLWORM PROBLEM. By F. Li. (*Ent. and Phytopath.*, iv. 16-17, Hangchow, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, 10, 1936, p. 669.) The bulk of this paper comprises a discussion from the literature of the history, distribution, food-plants and natural enemies of *Platyedra gossypiella* Saund., and of measures for its control. Lists are given of its food-plants and natural enemies, showing the countries in which they have been reported. Notes on some observations made by the author in China are included. In 1930 he found that infestation amounted to 15 per cent. of the cotton bolls, and that an infested boll contained 1-10 larvæ. The only other food-plant of *P. gossypiella* in China appears to be *Hibiscus syriacus*. The parasites recorded from it there are *Microbracon isomera*, Cushm.; *M. nigrorufum*, Cushm.; *M. onukii*, Watanabe; *Elasmus philippinensis*, Ashm.; *Brachymeria euplœæ*, Westw.; *B. obscurata*, Wlk.; *Dibrachys cavus*, Wlk.; *Eurytoma* sp.; *Pimpla* sp.; *Pristomerus* sp.; and *P. vulnerator*, Panz. In 1931, 45 per cent. of the resting-cycle larvæ were parasitized by *Microbracon* sp.

282. THE LETHAL POINT OF *Gelechia gossypiella* SAUND. AT HIGH TEMPERATURES. By M. Eguti. (In Japanese.) (*Ann. Agr. Exp. Sta. Korea*, 8, 2-3, 1936, p. 157. From *Rev. App. Ent.*, xxiv, Ser. A, 11, 1936, p. 698.) Larvæ of *Platyedra* (*Gelechia*) *gossypiella*, Saund. were kept at high temperatures for various periods,

and the following percentages of mortality were obtained; 81 in 2 hours and 100 in 3 hours at 50° C. (122° F.); 97 in 30 minutes and 100 in 40 minutes at 55° C. (131° F.); and 46 in 10 minutes and 100 in 20 minutes at 60° C. (140° F.).

283. PHOTOTROPISM OF *Gelechia gossypiella* (SAUND.) FOR PURPLE-COLOURED AND UNCOLOURED LIGHT TRAPS. By M. Eguti. (In Japanese.) (*Ann. Agr. Exp. Sta. Korea*, 8, **2-3**, Suigen, Korea, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, **11**, 1936, p. 698.) Of 1,502 adults of *Platyedra* (*Gelechia*) *gossypiella*, Saund., caught in light traps in Korea in 1934-35, 55·9 per cent. were attracted by purple lights and 44·1 per cent. by ordinary ones. The males far outnumbered the females in each collection. Most of the moths were caught in June, August and September, between midnight and 4 a.m.

284. ON SIMPLE METHODS OF FUMIGATING *Gelechia gossypiella* (SAUND.). By M. Eguti. (In Japanese.) (*Chosen Nokai Ho*, x., **3**, Korea, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, **12**, 1936, p. 787.) *Platyedra* (*Gelechia*) *gossypiella* is very injurious to cotton in Korea, and infestation by it has been found to be more severe in fields near cotton warehouses than in those at a distance from them. The larvæ generally leave the bolls when they are dried in the sun. Large numbers can be destroyed by fumigating the harvested bolls for twenty-four hours with carbon bisulphide or chloropicrin at the rate of 4 or 1·5 lb. respectively per 1,000 cu. ft. Such fumigation does not affect the germination of the seeds.

285. THE FUMIGATION OF BALED COTTON WITH HYDROCYANIC ACID. By A. C. Johnson and L. A. Hawkins. (*J. Econ. Ent.*, December, 1936, p. 1048.) In investigations carried on for some eight years on the fumigation of baled cotton to control pink bollworm, the dosage of hydrocyanic acid necessary to produce a complete kill of the insect, the effect of temperature, length of exposure, methods of removing the residual hydrocyanic acid from the cotton bale, and the proper method of stacking and introduction of the fumigant to obtain best distribution were determined.

286. NOTES ON THE LIFE-HISTORY OF *Agrotis ypsilon* ROTT. IN HANGCHOW. By K. Liu. (In Chinese.) (*Yearbook Bur. Ent. Hangchow*, **4**, 1934, p. 121. From *Rev. App. Ent.*, xxiv., Ser. A., **11**, 1936, p. 736.) *Agrotis ypsilon* attacks a large number of economic plants in Central China and the provinces along the south-east coast, and is particularly injurious to cotton seedlings. The female lays upwards of 1,500 eggs. The life-cycle occupies about a month, and four generations occur in a year, the adults emerging in mid-April, early June, late July, and early September. Hibernation takes place in the larval or pupal stage.

287. ON THE APHIDS OF COTTON AT MOPPO, KOREA. By O. Shinji. (In Japanese.) (*Oyo-Dobuts, Zasshi*, 8, **3**, 1936, p. 147. From *Rev. App. Ent.*, xxiv., Ser. A, **11**, 1936, p. 700.) *Aphis gossypii*, *Myzus persicæ*, *Macrosiphum* (*Acynthosiphon*) *gossypicola*, sp. n., which is described, and *Trifidaphis phaseoli* are recorded from cotton in Korea.

288. FURTHER STUDIES ON COTTON ROOT APHID. By C. F. Rainwater. (*J. Econ. Ent.*, December, 1936, p. 1092.) Further notes are given on the distribution, damage, and biology of three species of aphids injuring cotton in the South Atlantic States.

[*Cf. Abstr.* **292**, Vol. XIII. of this Review.]

289. METHOD OF REARING CORN EARWORM LARVÆ (*Heliothis obsoleta*). By G. W. Barber. (*J. Econ. Ent.*, December, 1936, p. 1175.) This method is made possible by the fact that corn ears picked before the tenth day after silking remain fresh and suitable as food long enough to rear the larvæ, and the larvæ do not as a rule migrate from the ears on which they are hatched. After harvesting the corn ears one or two newly hatched larvæ may be placed on the silks of each; the cobs of the ears are then impaled on nails driven through boards fitted into grooves inside a bottomless wire cage (dimensions given). This cage is placed over a cement slab with 8 inches of soil on it. In two or three weeks' time the full-grown larvæ may be recovered as they leave the corn ears and enter the soil to pupate.

290. Efficiency of *Trichogramma minutum* Riley, in Relation to Population Density of its Host. By G. W. Barber. (*J. Econ. Ent.*, xxix., **3**, 1936, p. 631.) Three examples were noted in two areas in Georgia of high rates of parasitism by *Trichogramma minutum* of eggs of *Heliothis obsoleta* on maize and soy beans, and of *Anticarsia gemmatilis* on soy beans. In all three cases host eggs were abundant. It would appear that *T. minutum* finds host eggs only by exploration, and if they are scarce or scattered the parasite population may decrease. Only when the population of the host becomes unusually great is the parasite found occurring in sufficient numbers to effect control. This is probably the explanation of the high efficiency of *T. minutum* in the examples given.

291. The Spotted Bollworms of Cotton in South Gujarat. By B. P. Deshpande and N. T. Nadkarny. (*Sci. Mono., No.* 10. Imp. Coun. Agr. Res., 1936.) An account of investigations on the spotted bollworms *Earias fabia* and *E. insulana*, financed by the Indian Central Cotton Committee. The various chapters deal with the life-history and habits of the pest, damage to the cotton crop, abundance of the bollworms in the cotton fields at Surat, behaviour of the cotton plant when free from bollworms, and estimation of the improvement in the yield of lint. The control measures discussed include: Removal of attacked shoots, trap crops, control by parasites, control by insecticides, and clean cultivation methods.

292. Biology of a Cotton Cutworm, *Agrotis* sp. in Hangchow. By K. Liu and C. Hwang. (In Chinese.) (*Yearbook Bur. Ent., Hangchow*, **4**, 1934, p. 241. From *Rev. App. Ent.*, xxiv., Ser. A, **11**, 1936, p. 737.) In China, the principal food-plants of this unidentified species of *Agrotis*, all stages of which are described, are maize and *Medicago denticulata*; it has also been found to attack fifteen species of winter crops, and damages cotton from late autumn to late spring or early summer. Eggs are laid in mid-November and hatch in thirty-two days. The larvæ æstivate in the ground from mid-May to September. Pupation occurs during September, and the adults emerge in October. Females may lay over 1,400 eggs.

293. A General Investigation of the Locust Outbreaks in China during 1935. By F. C. Woo and T. S. Cheng. (In Chinese, with English summary.) (*Spec. Pubn. No.* 14, Nat. Agr. Res. Bur., Nanking, China, 1936.) The migratory locust (*Locusta migratoria* L.) was considerably less prevalent in 1935, but outbreaks of the bamboo locust (*Ceracris kiangsu*, Tsai) were as serious as during the preceding year.

294. The Locust Incursion of 1935 in North-West India: Its Significance in the Study of the Locust Problem. By Y. Ramchandra Rao. (*Ind. J. Agr. Sci.*, vi., **5**, 1936, p. 1031.) The flights that are responsible for the starting of a new cycle of infestation in India would appear always to come from the direction of Mekran, Baluchistan.

295. Conditions of Existence and Individual Variability in the Asiatic Locust *Locusta migratoria*. By E. K. Zolotarev. (In Russian, with a summary in German.) (*Zool. Zh.*, xiv., **4**, Moscow, 1935. Abstr. in *Rev. App. Ent.*, xxiv., Ser. A, **7**, 1936, p. 451.)

296. Studies on *Schistocerca gregaria* Forsk. By M. A. Husain and C. B. Mathur. (*Ind. J. Agr. Sci.*, vi., **5**, 1936, p. 1005.) VIII. " Influence of Carbon Dioxide on Development of Black Pigmentation in *Schistocerca gregaria* Forsk."

[*Cf. Abstr.* **111**, Vol. XIV. of this Review.]

297. Compte-Rendu Sommaire sur les Recherches de la Mission d'Études de la Biologie des Acridiens dans la Région du Tchad en 1935. By B. N. Zolotarevsky. (*Bull. Soc. Hist. nat. Afr. N.*, xxvii., **3-4**, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, **7**, 1936, p. 466.) Deals with the field reconnaissance for locusts in the French Chad Territory carried out in 1935. Particulars of the itinerary and of the climate and vegetation in the areas visited are given.

298. Studies on the Chemotropism of *Dysdercus megalopygus*, Breddin. By K. Kobayashi. (In Japanese.) (*Oyo-Dobuts, Zasshi*, viii., **4**, Tokyo, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, **12**, 1936, p. 788.) In Formosa, the cotton stainer *Dysdercus cingulatus*, F. (*megalopygus*, Bredd.) attacks cotton, *Hibiscus* and various wild malvaceous plants. Near Taihoku it begins to migrate to cotton in mid-July. In experiments, the adults of both sexes were attracted to the flowers, leaves and fruits of cotton and other malvaceous plants and to dew on the cotton leaves. The bolls, which are the parts most injured in nature, were least attractive in the experiments. The bugs were also attracted by very dilute solutions of ammonium hydroxide, particularly at concentrations of from 10^{-7} to 10^{-5} per cent. and to a slightly less extent by trimethylamine at concentrations of from 10^{-7} to 10^{-4} per cent.

299. *Frankliniella gossypiana*, New Name. By J. D. Hood. (*Biol. Soc. Wash. Proc.*, 49, 1936. From *Exp. Sta. Rec.*, 75, **6**, 1936, p. 810.) The name *F. gossypiana* is proposed as a substitute for *Euthrips gossypii*, as *E. gossypii* has been used for quite a different insect occurring in Formosa. It is pointed out that this thrips is not restricted to cotton as a food plant.

300. The Control of Tsetse Fly in Southern Rhodesia. By R. W. Jack. (*Proc. and Trans. of Rhod. Sci. Asscn.*, xxxiv., **2**, 1936.) An outline of the life-history of tsetse fly is given, followed by an account of the measure of control effected by means of game destruction.

301. Cell Sap Acidity and the Incidence of White-Fly (*Bemisia gossypiperda*) on Cottons. By M. A. Husain *et al.* (*Curr. Sci.*, iv., **7**, Bangalore, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, **12**, 1936, p, 763.) *Bemisia gossypiperda*, Misra and Lamba, lays most of its eggs on tender leaves, on which later the nymphs feed, and in India the pest infests indigenous varieties of cotton more seriously early in the season, and American types in July or August. This behaviour is probably mainly dependent on some difference in the cell sap of the tender and older leaves, and to changes in the sap of the varieties during different parts of the year. Since the one easily measurable change in the sap is its pH value, investigations were undertaken in 1932-33 to test this in indigenous (Mollisoni) and exotic (289F.) types grown under identical conditions. Preliminary results showed that the pH gradient from top to bottom varied with the age of the plants. During 1932 the average pH values for the exotic variety were lower than those for the indigenous variety except in July and part of August, when the values for the two varieties were equal. The relative incidence of infestation corresponded with the trend of the pH curve, indicating partiality towards higher pH values. There was a certain amount of lag in the fluctuations of infestation, because the nymphs do not move, and probably also because some time is required before the effect of the change in the pH values is felt by the insects feeding on the sap. During 1933 the white-fly attack in general was insignificant, and the pH values were also relatively low.

[*Cf. Abstr.* **251**, Vol. XI. of this Review.]

302. Cultural Methods of Controlling Plant Diseases. By R. D. Anstead. (*Madras Agr. J.*, xxiv., **8**, 1936. From *Trop. Agr.*, Ceylon, November, 1936, p. 303.) A paper giving general support to Sir Albert Howard's thesis recently published. Mycologists and entomologists are said to be turning their attention more and more to the effects of soil and climate on the incidence of disease, and it is now becoming generally recognized that there are vast possibilities of controlling many plant diseases, not by attacking the disease organisms themselves, but by controlling conditions in such a way that these organisms are unable to develop because they find the conditions imposed deleterious to them. Examples are given of control of disease by cultural methods.

[*Cf.* Vol. XIII., p. 186, of this Review.]

303. The Nature of Immunity from Disease in Plants. By E. J. Butler. (*Rpt. 3rd Int. Congr. Compar. Path.*, i., **2**, 1936. French summary. From *Rev. App. Mycol.*, xv., **10**, 1936, p. 674.) In considering the problem of plant immunity the author emphasizes that as a rule the reaction of plant tissues is confined to the immediate neighbourhood of the infection site. Inherent or congenital resistance is, with few exceptions, influenced, apparently, by environmental conditions. Five kinds of acquired immunity are distinguished —viz., (1) that which follows an initial infection, and which has been definitely established only in the case of certain virus diseases; (2) local immunity following an initial infection, the recorded examples of which are not very convincing; (3) immunity acquired through vaccination, in connection with which it is pointed out that antibodies have not yet been demonstrated to be present in plants; (4) acquired intracellular immunity; and (5) immunity acquired by symbiosis, which may vary if the environmental conditions change.

The author concludes that analogies between animal and plant diseases should be confined within the limits of cellular pathology. In plants acquired immunity (wherever it has been established with certainty) appears to be no more than an intracellular phenomenon. No evidence has yet been produced to show that in plants antiparasitic action takes place at a distance remote from the immediate infection site.

304. L'Immunité aux Maladies Bactériennes des Plantes. By T. Savulescu. (*Rpt. 3rd Int. Congr. Compar. Path.*, i., **2**, 1936, p. 183. From *Rev. App. Mycol.*, xv., **10**, 1936, p. 677.) In the first part of this detailed account of present information on plant immunity to bacterial diseases the author deals with the question of resistance, the chief points discussed being mechanical resistance and physiological resistance, the latter considered under the headings of chemical resistance, resistance by pseudo-antibodies, resistance by intracellular digestion and by other means, and, finally, factors influencing natural resistance. The second part deals with the principles of acquired immunity, and is followed by other sections treating of passive, serological immunity, anaphylaxis, and bacteriophages. The author concludes that while the mechanism of plant immunity is not always comparable with that in animals, there are indications that the same laws govern immunity phenomena in all living things, that the use of vaccines, curative sera, and bacteriophages in the therapy of infectious plant diseases is a problem already solved in theory, and that it is now possible to make a synthesis of the pathogenesis of plant and animal diseases, considered from the same point of view, in the general framework of comparative pathology. A bibliography of 299 titles is appended.

305. Sudan: ***Cotton Diseases*, 1934-35.** By R. E. Massey. (*Ann. Rpt. Agr. Res. Serv.*, Sudan, 1935, received 1936.) Blackarm appeared somewhat earlier than the previous season, but owing to the absence of heavy late rains, spread was slow and localized. There was very little on the Gezira Research Farm, where debris of the previous crop had been collected and burnt and the land afterwards flooded. Further flooding experiments were carried on in other districts, and observations were made on the disinfection of seed—very important on account of the extensive use of home-grown seed. The effects of flooding were also studied in the laboratory.

Leaf curl appeared earlier than in the previous season, possibly because the white-fly began to breed sooner. Spread, however, was slow, and infection was even less than previously.

Wilt did not show the general outbreak of the preceding year, but the presence of discoloured seed in the terminal bolls of sympodia seemed to indicate that all was not well underground.

306. Bactericidal Properties of Hydrogen Sulphide. By V. I. Vzoroff. (In Russian, with English summary.) (*Bull. Pl. Prot.*, Leningrad, Ser. III., **6**, 1935. From *Rev. App. Mycol.*, xv., **10**, 1936, p. 669.) Brief details are given of laboratory experiments in 1934, the results of which showed that exposure of cottonseed infected with *Bacterium malvacearum* to an atmosphere containing 50 per cent. hydrogen sulphide for 72 hours, and of wheat seed infected with *Bacterium atrofaciens* to 30 per cent. hydrogen sulphide for 48 hours, effectively destroyed the bacteria without undue injury to the seed. Further tests showed that no revival of the organisms occurred after twenty days' storage of the treated seeds. The efficacy of hydrogen sulphide was apparently increased by lengthening the time of exposure rather than by increasing the concentration of the gas in the atmosphere. Aqueous solutions of hydrogen sulphide were highly toxic to the seeds.

307. Seedling Culture in Sand to Prevent Damping Off. By A. A. Dunlap. (*Phytopathology*, 26, **3**, 1936, p. 278. From *Exp. Sta. Rec.*, 75, **5**, 1936, p. 639.) In studies by the Connecticut Experiment Station, a large variety of seedlings were grown in washed sand with nutrient salts added in solution at time of planting. Similar cultures with treated and non-treated soils were grown under the same conditions for comparison. The best damping-off control was obtained by the sand-culture method. Seedlings grown in sand compared favourably with those from soil, and were more readily transplanted. Other desirable features in favour of sand culture were noted.

308. A Podridao Interna dos Capulhos do Algodeiro no Estado de Sao Paulo. (Internal Boll Rot of Cotton in the State of San Paulo.) By H. P. Krug. (*Bol. Techn. Inst. Agr. Campinas*, 23, **1**, 1936. From *Rev. App. Mycol.*, xvi., **1**, 1937, p. 35.) A summary is given of the available information on the history, host range, distribution, economic importance, symptoms, and ætiology of internal boll rot of cotton (associated with bacteria, *Nematospora coryli*, *N. gossypii*, yeasts, and *Penicillium* sp.) which was recorded during 1936 from six Experimental Stations in San Paulo, Brazil, causing 1·5 to 8 per cent. infection. Of the above-mentioned agents bacteria appear to be the most active in the causation of the disorder, which is transmitted by *Dysdercus* spp. and other sucking insects. In this way infection is conveyed to various wild and cultivated Malvaceæ, such as *Sida* and *Hibiscus*, and so perpetuated. *N. coryli* was isolated at Campinas from cowpeas, from which it may be transmitted to cotton by *Nezara viridula*.

309. Control of Root Rot. By H. W. Barre. (*Rpt. of the Chief of Bur. of Plant Industry, U.S.A.*, 1936.) A simple method that has proved beneficial and practicable under some conditions in controlling the root rot disease of cotton, and in increasing yield, has been developed at the Bureau's station at Sacaton, Arizona, in experiments continued over a series of years. It consists in applying animal manures and various forms of green manures or crop residues in deep furrows, covering them deeply, irrigating to encourage rotting, and planting the cotton over the buried material. The results are usually evident the first year, but become more striking after the practice has been maintained for two or three years, until in some experiments where the treatment had been continued for several years on severely infested land the damage from the disease was reduced until it was almost negligible. The applicability of the method in non-irrigated areas has not been demonstrated.

310. HOST RANGE OF THE GUJARAT COTTON ROOT ROT. By V. N. Likhite. (*Proc. Ass. Econ. Biol., Coimbatore*, iii., 1936, p. 18. From *Rev. App. Mycol.*, xv., **10**, 1936, p. 648.) A field test carried out in Baroda showed the following hosts to be susceptible to *Macrophomina phaseoli*, the causal organism of the local form of cotton root rot: sorghum, the smaller varieties of castor (*Ricinus communis*), *Hibiscus cannabinus*, *H. esculentus*, *H. sabdariffa*, groundnut, tobacco, sesame, soybean, papaw, tomato, egg plant and *Dolichos biflorus*, the fungus being isolated from the diseased plants. The fungus was also present on a number of apparently healthy plants and on certain weeds.

311. PHYMATOTRICHUM ROOT ROT ON WINTER AND SPRING WEEDS OF SOUTH CENTRAL TEXAS. By J. J. Taubenhaus. (*Amer. J. Bot.*, 23, **3**, 1936, p. 167. From *Exp. Sta. Rec.*, 75, **5**, 1936, p. 643.) Studies made by the Texas Experiment Station clearly showed that *P. omnivorum* can survive on fourteen different winter and spring weeds normally growing in fallow fields and in fields devoted to permanent cotton or to corn. Such weeds may act as bridging hosts, enabling root rot to spread to succeeding cotton crops or to summer annual and perennial weeds which are nearly always present in corn or fallow fields.

312. OZONIOSIS: TEXAS ROOT ROT AND ITS ANALOGUES. By M. S. Dounin and V. M. Poner. (In Russian, with English summary.) (*State Publ. Off. Lit. Collect. Co-op. Farming, Selkhozgiz*, Leningrad, 1936. From *Rev. App. Mycol.*, xv., **11**, 1936, p. 718.) This is a very complete compilation from the relevant literature (255 titles of which are cited in the appended bibliography) of information on the Texas cotton root rot (*Phymatotrichum omnivorum*), supplemented by some experimental, chiefly confirmatory, work by the authors with material imported from the United States.

313. STENOSIS IN GUJARAT COTTON. By V. N. Likhite. (*Proc. Ass. Econ. Biol. Coimbatore*, iii., 1936, p. 15. From *Rev. App. Mycol.*, xv., **10**, 1936, p. 648.) Cotton stenosis is stated to have been observed at Baroda Experiment Station since 1931; the condition usually affects the cut ratoon crop, though it may occur on a smaller scale in fresh and old crops, and diseased plants are liable to die early. Various attempts to transmit the disorder by grafting were unsuccessful, and it is doubtful whether it can be due to a virus. *Crotalaria juncea*, egg plant, and sesame were also affected by a similar malformation.

314. DIAGNOSTIC EVALUATION OF THE MORPHOLOGICAL AND CULTURAL CHARACTERS IN THE GENUS *Fusarium*. By Mme. A. I. Raillo. (In Russian, with English summaries.) (*Bull. Pl. Prot.*, Leningrad, Ser. II., **7**, 1935. From *Rev. App. Mycol.*, xv., **10**, 1936, p. 684.) In the first part of the paper the author indicates the difficulties inherent in Wollenweber's and Wollenweber and Reinking's classification of the genus *Fusarium*, claiming that these are chiefly due to the fact that most of the characters used by them in establishing their system are casual and insufficient for diagnostic purposes. She then gives a detailed and fully tabulated account of her own studies of the morphological and cultural properties of 17 species of *Fusarium*. In the second part studies are

described on the variability of the morphological and cultural behaviour of different single-spore isolates from single-spore cultures of the different species.

315. Immunity in Plants and Immunity to Fusarium Wilt in Cotton. By T. Fahmy. (*Rpt. 3rd Int. Congr. Compar. Path.*, i., **2**, 1936, p. 143. French summary. From *Rev. App. Mycol.*, xv., **10**, 1936, p. 648.) In the first part of this paper the author distinguishes and discusses, with numerous examples, three factors influencing the reaction of plants to disease—viz., the genetic composition of the host, the strain of the parasite, and the conditions favouring infection. In the second part he concisely summarizes his work since 1923 on the genetics of resistance to cotton wilt (*Fusarium vasinfectum* var. *ægyptiacum*).

316. Potash for Cotton Wilt and Rust in South Mississippi. By L. E. Miles. (*Better Crops with Plant Food*, 20, **9**, 1936. From *Exp. Sta. Rec.*, 75, **5**, 1936, p. 644.) The use of a fertilizer containing an adequate amount of potash, and measures increasing the humus content of the soil, are suggested for wilt control.

317. Fertilize to Control Cotton Wilt and Rust. By V. H. Young. (*Better Crops with Plant Food*, 20, **7**, 1936. From *Exp. Sta. Rec.*, 75, **5**, 1936, p. 644.) Provided root knot is absent, cotton wilt and rust can be practically eliminated if a resistant strain of cotton is grown and enough potash is applied to control rust or potash hunger.

318. The Effect of Temperature on the Growth of *Fusarium vasinfectum*. Atk. By M. Mitra and K. F. Kheswalla. (*Ind. Acad. Sci. Proc.*, ii., 1935, No. 6, Sect. B. From *Exp. Sta. Rec.*, 75, **4**, 1936, p. 501.) *F. vasinfectum*, causing cotton wilt in Western India, was found to have an optimum temperature of about 25° C. when grown in fluid or solid media. The minimum appeared to be a little below 13° to 14° and the maximum between 35° and 40°.

319. Immunity to Virus Diseases in Plants. By R. N. Salaman. (*Rpt. 3rd Int. Congr. Compar. Path.*, i., **2**, 1936, p. 167. From *Rev. App. Mycol.*, xv., **10**, 1936, p. 676.) In this full review of the data regarding immunity from virus diseases in plants, the author contrasts this immunity with that found in animals, commenting on the lack of evidence for the existence of antibodies in plants, and classifies the types of immunity as real or apparent (when plants recover from symptoms but remain infective). A further type is afforded by carriers. True immunity may be local or systemic; active acquired immunity has been demonstrated, but no examples of passive acquired immunity are known. The author concludes that while immunity in animals is largely humoral and only to a minor extent cellular in character, in plants it is largely if not entirely cellular.

320. Virus and Genic Reactions in Morphogenetic, Physiogenetic and Phylogenetic Aspects. By D. Kostoff. (*Phytopath. Z.*, 9, 1936, p. 387. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 175.) The author presents an attempt to integrate the findings in the two branches of science concerned with the study of the gene and of viruses. The principal points of similarity and dissimilarity in the mode of action and the effects produced by these two agencies of change are set forth with copious references to relevant literature. In conclusion, attention is drawn to the function of viruses in the production of diversity due to the formation of abnormal germ cells which may have a phylogenetic value. Virus diseases may also be accompanied by an increased genic mutation rate, which may also have important consequences in phylogeny.

321. Pilosity of the Cotton Plant in Relation to Adherence of Dusted Calcium Arsenate. By E. W. Dunnam. (*J. Econ. Ent.*, December, 1936, p. 1087.) Of the two varieties of cotton under test in calcium arsenate-dusting experiments in 1935 at Stoneville, Mississippi, the more pilose retained more arsenic pentoxide under all like conditions. The smooth variety when dusted wet retained more poison than the hairy variety when dusted dry.

GENERAL BOTANY, BREEDING, ETC.

322. LE PORT ET LA PATHOLOGIE DU COTONNIER: INFLUENCE DES FACTEURS MÉTÉOROLOGIQUES. By R. L. Steyaert. (*Ser. Sci.*, *No.* 9, Inst. Nat. Etud. Agron., Congo Belge, 1936.) This careful statistical study was carried out with Triumph Ordinary and Farm Relief cottons in Uele, Belgian Congo, in 1934-35. In this district the development of leaf, flower and fruit depends primarily upon atmospheric temperature, the correlation coefficients relative to this factor being always negative and significant, thus indicating that the cotton plants were growing in too high a temperature. The most important of the humidity coefficients were the daily rainfall and the relative humidity, the latter especially influencing the persistence of the leaves and the development of the green bolls. Much injury is caused to the flowering by frisolée and to the bolls by *Helopeltis*. *Bacterium malvacearum* is of secondary importance in Uele owing to climatic reasons, but the severe losses caused by internal boll rots merit serious attention. It is thought that a more judiciously chosen sowing date may result in a great reduction of these losses. All the evidence of the study goes to show that climatic conditions play a part of the highest importance in cotton growing.

323. LA PURIFICATION DU TRIUMPH BIG BOLL DANS L'UELE. By M. Waelkens. (*Ser. Tech. No.* 9, 1936. L'Inst. Nat. pour l'Etude Agronomique du Congo Belge.) An account of selection work carried out with Triumph Big Boll cotton. Pedigree line 145 is showing an improvement in quality and yield, and 15P4, with a white cotton of 29-30 mm., is also promising.

324. THE MICROSCOPE. By S. H. Gage. (Comstock Pubg. Co., Ithaca and New York. $4.00. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 255.) A textbook of the microscope and microscopical methods for students and research workers. After a chapter on microscopes and their parts, the author describes in some detail bright-field microscopes and their use, then dark-field microscopy, the polarizing microscope and the optics involved in microscopy, the micro-spectroscope and the ultra-violet microscope. There follow chapters on the interpretation of appearances, magnification and measurement, drawing and demonstrations and on photography. Over 100 pages are devoted to the topics usually included under microtomy, followed by a new chapter on micro-incineration and a brief history of lenses and microscopes. The book concludes with a bibliography, an index, a table of natural sines and data for changing from metric to English measures and from Centigrade to Fahrenheit.

325. RAW COTTON: COLOUR. By O. Roehrich. (*Coton et Cult. Cotonn.*, **10** 1936, p. 78. From *Summ. of Curr. Lit.*, xvi., **20**, 1936, p. 582.) A method of measuring the colour of raw cottons is described which depends on measurements with a Toussaint photocolorimeter of the transmissions in the violet, blue, green, yellow, orange and red regions of the spectrum expressed as percentages of the transmissions of a magnesium oxide surface under similar conditions. The luminosity or mean tone is given by the average of the six percentages; its influence on colour is discussed. The ratio of average transmission in the violet and blue to average transmission in the orange and red, expressed as a percentage, is suggested as a measure of coloration. Results are given for various types of cottons, and their positions are plotted on a chart with luminosity and coloration as co-ordinates.

326. NATURAL SELECTION AND EVOLUTIONARY PROGRESS. By J. S. Huxley. (*Nature*, 138, 1936, pp. 571 and 603. From *Pl. Bre. Absts.*, vii., 2, 1937, p. 132.) After discussing the nature of natural selection under conditions of Mendelian inheritance the author emphasizes the multiplicity of the processes which may be concerned in the origin of species. He then goes on to show that natural selection must be invoked to explain adaptation, and also demonstrates its importance in connection with long-range evolutionary trends. The effect of genes affecting the rate of certain processes is shown to be capable of important repercussions. In conclusion, the nature of evolutionary progress is discussed, with special reference to man.

327. HAS MENDEL'S WORK BEEN REDISCOVERED ? By R. A. Fisher. (*Ann. Sci. London*, 1, 1936, p. 115. From *Pl. Bre. Absts.*, vii., 2, 1937, p. 131.) A careful examination of Mendel's classical paper on plant hybridization, with observations on the reaction of Mendel's contemporaries to his work, and also its use by Bateson in connection with the latter's opposition to the theory of Natural Selection, which theory is shown to be in fact not incompatible with Mendel's views. The paper itself is shown to be most probably a literal account of Mendel's experiments. It is also shown by the χ^2 method that there is a tendency throughout for the experimental results to fit too well; moreover, in the testing of gametic ratios the experimental results gave better agreement with ratios which do not take into account the fact that a proportion of heterozygous plants would give nothing but dominants (owing to the small progenies grown) than they did with the ratios which ought to occur if allowance were made for this. The general conclusions are reached that Mendel had deduced the factorial theory of inheritance beforehand and planned his experiments with it in mind, and also that the numerical ratios obtained he regarded, at any rate after his very first experiments with seed characters, as a demonstration for others rather than for his own enlightenment, for he ignored many opportunities of verifying them. The general tendency of other workers reading Mendel's paper seems to have been to find what they expected to find, and to ignore what they did not expect to find. The author concludes that only a succession of publications and the continuous iteration of all new opinions seem sufficient to bring about the general recognition of a new discovery.

328. BACK-CROSSING AND ITS USE IN PLANT BREEDING. By L. C. Miles. (*J. Aust. Inst. Agr. Sci.*, 1, 1935, p. 163. From *Pl. Bre. Absts.*, vii., 2, 1937, p. 131.) It is shown theoretically that back-crossing a hybrid for six generations to a homozygous parent without selection should result in sufficient homozygosity for practical purposes. Hence to transfer a single dominant factor from one variety to another the procedure recommended is to cross the two and back-cross to the latter variety for five or six generations, selecting for the character in each generation. This will yield a progeny identical with the second variety, but heterozygous for the character being transferred. The desired homozygous form will then be obtained on selfing. When the character to be transferred is recessive the programme must be lengthened by periodic selfings to bring to light the recessive character. Even after three generations of back-crossing, one-eighth of the progeny should carry the recessive factor in the heterozygous condition.

329. RECENT DEVELOPMENTS IN GENETICS AND PLANT BREEDING. By I. F. Phipps. (*J. Aust. Inst. Agr. Sci.*, 2, 1936, p. 107. From *Pl. Bre. Absts.*, vii., 2, 1937, p. 132.) A summary of an address on the results of modern research in these two fields.

330. COTTON PLANT: GENETICS. By J. M. Webber. (*Science*, **84**, 1936, p. 378. From *Summ. of Curr. Lit.*, xvii., **22**, 1936, p. 656.) Notes are given on the F_1 hybrids involving: (1) cultivated American species; (2) cultivated Asiatic species; (3) wild American species; (4) a wild Asiatic species, *G. stocksii* M. Mast.; (5) a wild African species, *G. anomalum* Wawra and Peyr; (6) a wild Australian species, *G. Sturtii* F. v M.; (7) *Thurberia thespesioides* A. Gray, a wild American plant, closely allied to *Gossypium*. Each of these groups, with one exception, has the haploid chromosome number 13; in the cultivated American group the haploid number is 26. The results of cytological studies give support to Skovsted's assumption that the cultivated American cottons were derived from a cross between a wild American species and a species having a chromosome complement similar to that of the cultivated Asiatic cottons. *Thurberia thespesioides* appears to be congeneric with *Gossypium*.

331. TRAVAUX DE SÉLECTION DU COTON. By M. Waelkens. (Publ. Inst. Agron. Congo Belge. Ser. Tech. No. 5, 1936. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 213.) The value of three methods for measuring the fibre is considered—namely, the single fibre method, the halo or Bailey method, and the method of individual readings. Of these the last is preferred as being more exact. Mass selection has been abandoned at the Bambesa Station in favour of pedigree selection. There has been a steady increase in length and regularity of fibre. Two families, 125 and 270, are in process of multiplication. The first is especially commended for earliness, yield and fibre of about an inch, but the halo is rather irregular. The second, though not so early, has a very regular fibre but shorter than that of the first family; the yield is equally good. The hybrids from the crosses Triumph × Columbia, Triumph × Durango, and Triumph × Acala are in the F_2. The progeny of the last cross is the most satisfactory.

332. AN INVESTIGATION OF CHROMOSOME MORPHOLOGY IN THE GENUS *Gossypium*. By L. G. Arutjunova. (*C. R. [Doklady] Acad. Sci. U.S.S.R.*, iii., **12**, 1936. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 213.) Use was made of various fixatives elaborated by Levitsky for the detection of chromosome morphology, and giving better results than his original " weak chromic formalin." The species studied were *G. herbaceum* ($2n=26$) and *G. hirsutum* ($2n=52$). The platinic formalin solution proved the most successful. In *G. herbaceum* thirteen chromosome types were established, seven of which showed secondary differentiations. About one-third of the chromosomes are much smaller than the others. In *G. hirsutum* each type appeared to be present twice, suggesting that the species is of autopolyploid origin, and not an amphidiploid as stated by Skovsted. If it is an amphidiploid, it must have arisen from two very similar species.

333. ON PURE LINES. By S. A. Rodicev. (In Russian.) (*Selektsija i Semenovodstvo*, **4**, 1936, p. 23. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 165.) The author defends the view that any so-called pure line in reality consists of a large number of segregates, differing in their genetical constitution as regards many physiological characters, some being above the mean, others below, the average for the line as a whole remaining much the same from generation to generation. The proportion of the different components can, however, change if environmental conditions change in such a way as to favour one type more than the other. If it is a less desirable type that is favoured over a number of seasons, then the variety can truly be said to have " degenerated." Most old varieties should, therefore, be susceptible of improvement both by further selection and by Lysenko's method of crossing within the variety.

334. CHROMATIN, CHROMOSOMEN, GENE. By G. Haase-Bessell. (*Planta*, **25**, 1936, p. 240. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 165.) An argument is presented in favour of the theory that the chromosomes are to be regarded as colloidal systems, the genes as highly specialized catalysts, and the matrix as a co-ordinating medium for the reaction products and ensuring the correct biological functioning in the whole organism.

335. THE GENE, ITS FUNCTION AND ITS MEANING IN GENETICS. By W. F. H. Stroer. (*Quart. Rev. Biol.*, **11**, 1936, p. 57. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 132.) A discussion of many of the modern viewpoints on the nature and action of the gene, in which the view is represented that the genes are not to be regarded as units composing the organism, but as portions of the organism which direct but do not necessarily control its course of development.

336. THEORETICAL AND PRACTICAL IMPORTANCE OF SEED REJUVENATION. By N. M. Rjabov. (*Selektsija i Semenovodstvo*, **3**, 1936. From *Pl. Bre. Absts.* vii., **2**, 1937, p. 164.) A brief recapitulation of Lysenko's theory. Figures are given to show that the relative fall in heterozygosity with successive generations becomes greater with the number of segregating characters, and increases in more than geometrical progression from generation to generation.

337. INTERSPECIFIC HYBRIDIZATION IN COTTON. By B. J. Thaka and K. C. Amin. (*Poona Agr. Coll. Mag.*, **28**, 1936, p. 19. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 143.) A list is given of the successful crosses between Old and New World cottons made at the Cotton Breeding Station, Surat. From over four thousand crosses, nineteen mature seeds were obtained from eleven bolls. Of these thirteen gave hybrid plants, three of which have since died, three failed to germinate, and three gave plants of the maternal type.

338. CROISEMENT INTERSPECIFIQUE DES COTONNIERS: NOTE COMPLEMENTAIRE. By J. F. Szymanek. (*Cot. et Cult. Cotonn.*, **10**, 1936, p. 59. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 212.) The F_1 hybrids of *G. hirsutum* × *G. herbaceum-indicum* and of *G. vitifolium* × *G. herbaceum-indicum* resembled at first sight the maternal parent (*G. herbaceum*) in morphological characters, though a detailed examination showed traces of the influence of the male parent in a tendency towards a reduction in the number of lobes of the leaf, in relation between length and breadth of the leaf in the first cross and in the depth of lobing and size of fruit in the other. The yield and the quality of the fibre of both these hybrids surpassed those of either parent. The F_1 hybrids of *G. hirsutum* × *G. punctatum* and of *G. vitifolium* × *G. punctatum* were intermediate in character. The progeny of the first cross showed valuable economic characters; that of the second has fibre of mediocre quality, but this was improved in the reciprocal cross.

339. UNTERSUCHUNGEN ÜBER DIE NATUR DER MUTATIONEN. By M. S. Nawaschin. (*Probleme der theoretischen Biologie, Arbeiten aus dem Timirjaseff-Inst. für Biologie, Moskau*, 1935. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 166.) A brief account of the author's work on the process of mutation in ageing seeds, and its acceleration by increased temperature and humidity, with special emphasis on the theoretical aspect. The importance of heat, humidity and ageing with reference to breeding and seed-growing respectively is discussed, and its significance for ecology is also mentioned.

340. STUDIES IN THE CORRELATION AMONG THE CHARACTERS OF ASIAN COTTON VARIETIES AND THEIR F_2 HYBRIDS. By J. Onodera. (*Proc. Crop. Sci. Soc.*, **8**, Japan, 1936, p. 151. From *Pl. Bre. Absts.*, vii., **2**, 1937, p. 212.) Varieties from Japan proper, Korea, Manchuria, China, and India, and their F_2 hybrids were used in this study, which showed flowering time to be markedly correlated with other characters, and to be important in the selection of early maturing varieties; it should, therefore, be investigated as well as the time of dehiscence of the bolls. The lint index appeared to be more significant as a factor determining ginning outturn in the Asiatic cottons than in the American or Egyptian forms. Early-maturing varieties are distinguished by early flowering, light capsules, a high percentage of burst capsules and light small seed. By correlation studies in the F_2 linkage was revealed between flowering time, lint index, plant height, length of internodes, of halo and of the largest sympodial branch. A more fundamental study of the true correlations with the elimination of interference was recognized as essential.

FIBRES, YARN, SPINNING, WEAVING, ETC.

341. COTTON AND STAPLE FIBRE YARNS: COMPARISON. By A. Grote. (*Kunstseide*, xviii., 1936, p. 355. From *J. Text. Inst.*, xxvii., **11**, 1936, A554.) A 26's combed cotton yarn and a 26's viscose staple fibre yarn were compared in regard to regularity of twist, breaking load and extension and regularity in these properties. The results show the superiority of the cotton yarn. Observations of the untwisting of the yarns, and the degree of untwisting that can be effected before break occurs when the yarn is subjected to a load which is 75 per cent. of its breaking load, have shown that the adhesion between the fibres in the staple fibre yarn is greater than in the cotton yarn. This is attributed to the fact that the single staple fibres are finer than the cotton hairs, and a cross-section of the staple fibre yarn contains a greater number of fibres than a section of the cotton yarn, and also to the greater staple length of the staple fibres. Tests with the Frenzelhahn continuous tester show that for a given extension the tension produced in the staple fibre yarn is higher than that produced in the cotton yarn, and the liability of breaks in processing is greater with the staple fibre yarn.

342. MILDEWED COTTON FIBRES: MICROSCOPY. By B. Prindle. (*Text. Res.*, **6**, 1936, p. 481. From *Summ. of Curr. Lit.*, xvi., **21**, 1936, p. 619.) A method of detecting and observing changes in the structure of cotton fibres under attack by mildew consists in staining the fibre with a 0·15 per cent. aqueous solution of Victoria Blue B, and then swelling the dyed fibre on the microscope slide in cuprammonium solution containing not more than 0·8 per cent. copper. Full details are given. The appearance of typical samples of normal and badly mildewed cotton are shown in a series of photomicrographs.

343. VEGETABLE FIBRES: STRUCTURE. By A. Sakostschikoff. (*Helv. Chim. Acta*, **19**, 1936, p. 973. From *Summ. of Curr. Lit.*, xvii., **1**, 1937, p. 15.) The author replies to Haller's denial of the existence of transverse structures in cotton and other vegetable fibres by showing that modifications introduced by Haller in the author's technique were sufficient to account for his failure to obtain the same effects. In particular, the sulphuric acid used by Haller was too weak, and his method of washing by water too slow. The acid should be at least 93-94 per cent.

[*Cf. Abstrs.* **329** and **500**, Vol. XIII. of this Review.]

344. COTTON HAIR: X-RAY INVESTIGATION DURING GROWTH. By K. Hess *et al.* (*Planta*, **25**, 1936, p. 419. From *J. Text. Inst.*, xxviii., **1**, 1937, A35.) With the aid of X-ray methods two easily distinguishable crystalline constituents can be detected in growing cotton hairs. The one is only present during cell elongation, and is called the primary substance. The other first appears after completion of elongation, that is, at the beginning of the secondary thickening of the cell-wall. This is the crystalline form of cellulose, which is confirmed by micro-chemical and optical data. The conclusion is drawn that crystalline cellulose is not present during the lengthening phase; amorphous cellulose may be present.

345. A NEW METHOD AND APPARATUS FOR DETERMINING THE AVERAGE LENGTH AND FINENESS OF COTTON HAIRS. By N. Ahmad and C. Nanjundayya. (*Tech. Bull., Ser. B, No.* 21. Ind. Cent. Cott. Comm., 1936) The new method consists in " cutting a representative tuft of fibres, with one end in alignment, into three parts; the first part extending to a known length from the aligned end, the second part also having a known length, and the third varying. The three parts are separately weighed. The average length of the third portion is computed by multiplying the ratio of the weight of the third part to that of the first by the known length of the first part. The average length of the whole tuft is obtained by adding up the individual lengths of the three parts. Furthermore, the fibre-weight per unit length may also be determined by counting the number of fibres in the first section prior to weighing, and dividing the weight of the tuft by the number of fibres and the average length. An apparatus, designed to carry out the tests accurately and rapidly, is described."

346. COTTONSEED LINT: DETERMINATION. By R. S. McKinney and G. S. Jamieson. (*Oil and Soap*, xiii., 1936, p. 139. From *J. Text. Inst.*, xxvii., **11**, 1936, A552.) A method for estimating lint on cottonseed is described in which the lint is destroyed by " fuming " with hydrochloric acid at 130° C. Duplicate determinations agree within 0·2 per cent., and are comparable with plant yields. A further method is also outlined by which the proportions of hulls and cellulose in " hull fibre " can be calculated.

347. I. COTTON OPENING AND PICKING. II. COTTON DRAWING AND ROVING. By G. R. Merrill. (Lowell Textile Inst., Lowell, Mass., U.S.A. Price $1·75 and $2·75 respectively. Reviewed in *J. Text. Inst.*, xxvii., **10**, 1936, P355.) These are the first two of a set of books prepared by Prof. Merrill primarily for his students in textile technology at the Lowell Textile Institute, Massachusetts. The first book consists of 55 pages, the second of 54 pages of quarto size. The notes are typewritten, illustrated, and interleaved with blank sheets on which additional notes may be added for any new development in the field covered, adjacent to the original notes. The author has gained a reputation for cotton mill organization which is well upheld in the books, and students of cotton spinning of all ages will find much helpful new information in them. They are right up-to-date, and include sections on cork-covered rollers of the Armstrong type about which nothing has yet appeared in print in English textbooks, and also sections on the modern roving frame high-draft methods. The drawings and diagrams are well executed and are valuable for reference.

348. THE EFFECT OF JUTE ON THE SPINNING VALUE OF COTTON. By W. L. Balls and H. A. Hancock. (*Int. Cott. Bull.*, xv., **57**, 1936, p. 97.) Gives the results of tests carried out under the particular conditions existing at the Spinning Test Mill at Giza, on a cotton of exceptionally good staple and grade, Fully Good Sakel, and one of a lower grade, Giza 7 Fully Good Fair. In both cases the effect of small amounts of jute was almost negligible, and even the increase from 1 per cent. to 4 per cent. jute depreciated the yarn strength so little that it appeared possible to include much more jute without breakdown. The authors hesitate to say to what extent these results apply to normal industrial conditions, since the deviations from ordinary spinning practice may result in the jute fibres disturbing the processing less.

349. COTTON YARNS: MOISTURE RELATIONS. By R. Setzer. (*Textilber*, **17**, 1936, p. 714. From *Summ. of Curr. Lit.*, xvi., **21**, 1936, p. 620.) Discusses an arrangement for studying the rates of adsorption and desorption of moisture by cotton yarn and cotton roving.

350. COTTON YARN: STRENGTH CALCULATION. By P. Meyer. (*L'Ind. Text.*, **53**, 1936, p. 425. From *J. Text. Inst.*, xxviii., **1**, 1937, A38.) In order to calculate the strength of a given yarn it is necessary to know the quality of the cotton, the count of the yarn and the state of twist of the latter. The influence of each of these factors is examined. Formulæ are deduced and their use is illustrated by examples of calculations of the strengths of various yarns.

351. TANGUIS UNDERWEAR YARN: SPINNING. (*Text. Wkly.*, **18**, 1936, p. 449. From *Summ. of Curr. Lit.*, xvi., **22**, 1936, p. 642.) Difficulties encountered in spinning Tanguis cotton for underwear are discussed, and hints are given on cleanliness, roller settings, and fitting new traverse cams. Tanguis cotton is easy to spin after combing; it is less affected by static electricity than fine cottons, and works better in a dry atmosphere than does American cotton of the same staple.

352. IBAN OR SEA DAYAK FABRICS AND THEIR PATTERNS. By A. C. Haddon and L. E. Start. (Pubd. Camb. Univ. Press. Price 25s. net. Reviewed *J. Text. Inst.*, xxvii., **11**, 1936, P269.) A book of great interest to all engaged in the study of history of design. It is a survey of the fabric structure and design of one of the primitive peoples of Borneo, the Iban or Sea Dayaks, who have settled on the coast of Sumatra. Details are given of the production of cotton fabrics, including primitive forms of the ginning, spinning and weaving processes. The native shedding mechanism for plain or tabby weave cloths is a very ingenious device. It consists of a simple thick rod which passes below odd and above even threads, thus forming one of the sheds, and in front of this rod, above the warp, is a second rod from which depends a series of loops of cord, each passing under an even warp end. The raising of this rod or heald lifts up the even threads and thereby forms a second shed. The book is furnished with some excellent drawings.

353. TEXTILE FIBRES AND THEIR USE. By K. P. Hess. (J. P. Lippincott and Co., U.S.A. Reviewed in *J. Text. Inst.*, xxvii., **10**, 1936, P358.) This book, which is profusely illustrated, is a completely rewritten and reset edition of the author's previous work under the same title, and is primarily published for use in America.

[*Cf. Abstr.* **446**, Vol. IX. of this Review.]

354. TEXTILE FIBRES: STRUCTURE AND PROPERTIES. By W. T. Astbury. (*Nature*, **138**, 1936, p. 824. From *Summ. of Curr. Lit.*, xvii., **1**, 1937, p. 15.) A brief summary is given of papers, bearing on the structure and physical properties of fibres, read at the British Association meetings, 1936.

LEGISLATION.

355. RULES FOR REGULATING THE IMPORT OF PLANTS, ETC., INTO BRITISH INDIA. *Notification No. F.*320/35-*A., dated July* 20, 1936. (*Ind. J. Agr. Sci.*, vi., **6**, 1936, p. 1338.) Includes regulations governing the importation of unginned cotton by sea or by air, and of cotton seed at the port of Bombay.

356. NIGERIA: *Regulations made under the Importation of Plants Regulation Ordinance*, 1935 (*No.* 4 *of* 1936). (*Rev. App. Mycol.*, xvi., **1**, 1937, p. 79.) *Cotton:* Prohibits the importation of all cotton seed unless free from lint. The importation of cotton from West African countries included in the Plant Interchange Schedule is allowed only under permit signed by the Director of Agriculture.

357. SOUTHERN RHODESIA: *Cotton Research and Industry Act*, 1936 (*No.* 38, 1936). "An Act to establish a Board to supervise research work on cotton and on insect pests and diseases affecting cotton and other matters connected therewith, and to assist the development of the cotton industry in the Colony" and for other purposes.

358. UNITED STATES: *Service and Regulatory Announcements, January-March,* 1936. (*S.R.A.*, *B.E.P.Q.*, No. 126, Washington, D.C., June, 1936. From *Rev. App. Ent.* xxiv., Ser. A, **12**, 1936, p. 746.) In addition to other announcements relating to plant quarantines in the United States, one relating to Quarantine No. 52 approves two alternative methods for the treatment of baled cotton lint moved from areas heavily infested with the pink bollworm. Baled lint has hitherto been given both vacuum fumigation and either compression or roller treatment. In future the flat bale may be subjected to a steam pressure of not less than 15 lb. per sq. in. for not less than three minutes at a temperature of not less than 150° F., at a depth of 3 inches from the surface of the bale at all points, provided that this treatment is followed by standard or high-density compression. Alternatively, the lint of such bales may be passed between revolving rollers that are of adequate weight and set sufficiently close to crush all cottonseed and kill all pink bollworms present. The premises and the coverings of the bales must be uncontaminated, and the bales must be moved directly from the press to a situation adequately safeguarded against contamination.

TRADE, PRICES, NEW USES.

359. WORLD COTTON PROSPECTS. (*Text. Wkly.*, xviii., **455**, 1936, p. 567.) A world crop of about 30,000,000 bales is expected, the previous record having been 28,417,000 bales in 1926-27. Consumption, however, is at a high level, and the carryover has been reduced. Details of acreage and production are given for some of the chief producing countries.

360. THE COTTON ASSOCIATION: CONTRACTS FOR EVERY VARIETY. By A. C. Nickson. (*Ann. Trade Rev.* 1936, *Man. Guar. Coml.*, 29/1/37, p. 63.) The American cotton position was very disappointing, and the reasons for this are discussed. The American and Outside Growths contract which came into force during the year did not realize the hopes expected, and much thought is being given to evolving a contract which will provide a satisfactory hedge for most growths of cotton and which will be of assistance to the trade generally. The change-over to the new Universal Standards, which became operative in 1936, was effected smoothly, and it is hoped that they will last for a considerable period without alteration. The new futures contract for Giza 7 Egyptian cotton also came into force during the year, and trading in it has proved satisfactory. Close harmony existed between members of the Association and the Federation of Master Cotton Spinners, and also with the International Spinners' Federation; it is realized that only by a frank exchange of views can the cotton industry in this country regain some of its past prosperity.

361. COTTON ROAD-MAKING FABRICS: APPLICATION. By G. H. Watson. (*Cotton, U.S.*, 100, **11**, 1936, p. 57. From *Summ. of Curr. Lit.*, xvii., **2**, 1937, p. 34.) Some details are given of an extended programme which is being fostered by the U.S. Dept. of Agriculture, in which some 6,167,000 square yards of cotton fabrics are being provided for the building of over 500 miles of roads in twenty-four States. The cotton fabric used resembles burlap bagging. It is laid down after the sand-clay and hard-surfacing asphalt coating, and before the finishing of asphalt and heavy and fine slag. The use increases road cost by about $1,000 per mile. Cotton fabrics are also to be used for curing concrete roads.

362. THE USE OF COTTON IN THE MOTOR-CAR INDUSTRY. (*Int. Cott. Bull.*, xv., **57**, 1936, p. 171.) According to Mr. Henry Ford, of the Ford Motor Co., every

million cars manufactured by his company entails the use of 69 million pounds of raw cotton for the making of upholstery, tyres, brake linings, timing gears and cellulose for safety glass. The United States motor-car industry consumes 487,000 bales of cotton per annum, or 9·1 per cent. of the total United States mill takings.

363. COTTON BAGS FOR SUGAR. (*Int. Cott. Bull.*, xv., 57, 1936, p. 171.) According to a recent issue of the American *Wool and Cotton Reporter*, a cotton bag to be used for packing raw sugar has been designed by technologists of the U.S. Bureau of Agricultural Economics in co-operation with North Carolina State College. The bag is to be put through a series of practical tests in transporting raw sugar from Hawaii to refineries in California, in comparison with sugar bags made of jute. All jute used in America is imported—chiefly from India. Cotton bags cost more than jute, but this disparity in cost may be overcome by developing a cotton fabric that can be re-used three or more times. Laboratory tests have demonstrated that the new cotton bag is much more durable than sugar bags made of jute. If the cotton bag can be used three times, it will be cheaper than jute, since jute bags can be used only once. If all imports of raw sugar were packed in cotton bags the consumption of cotton would be increased by about 50,000 bales a year.

364. THE RAW COTTON TRADE. By C. D. Milner. (*Branch Banking*, January, 1937.) An elementary sketch dealing with organization and finance.

365. THE EGYPTIAN COTTON SECTION OF THE LANCASHIRE COTTON INDUSTRY IN THE 1935-36 SEASON. By D. Windel. (*Egyptian Cotton Year Book*, 1935-36, p. 75.) The imports of Egyptian cotton into Lancashire amounted to 371,463 bales, compared with 355,323 bales in the 1934-35 season. On present prospects Lancashire will require some 350,000 bales of Egyptian cotton during the current season.

MISCELLANEOUS.

366. BRITISH COMMONWEALTH SCIENTIFIC CONFERENCE, LONDON, 1936: REPORT OF PROCEEDINGS. (Cmd. 5341. Pubd. H.M. Sta. Off., 1937. Price 1s. 3d. net.) A report of discussions upon the many problems of agricultural research and of organization and working that come before the various Imperial Bureaux and other bodies dealing with applied science.

367. AGRICULTURAL OUTLOOK CHARTS, 1937. (*U.S. Dpt. Agr., Bur. Agr. Econ.*, November, 1936.) *Cotton :* An instructive set of charts of farm prices from 1909-10 to date; acreage and production in the major cotton-growing countries of the world; world consumption and carryover of American cotton; prices; exports, etc.

368. TROPICAL HYGIENE. We have received a notice from the London School of Hygiene and Tropical Medicine (University of London) to the effect that the Annual Malaria Control Course for Laymen (Engineers, Planters, etc.) will be held at the Ross Institute of Tropical Hygiene, Keppel Street (Gower Street), W.C. 1, from Monday, June 21, to Friday, June 25, inclusive. The course is free and will be under the direction of Sir Malcolm Watson, Director of the Ross Institute. Early application should be made to the Organizing Secretary at the above address.

ERRATUM.

THE EARLY DEVELOPMENT OF THE COTTON FIBRE. By F. M. L. Sheffield. The following note has been received from the author:

" Dr. Turner has drawn my attention to an apparent misrepresentation in my paper on 'The Early Development of the Cotton Fibre' of his views regarding the differentiation of cotton hairs. The view which Dr. Turner contested is the later one of Balls published in 'The Development and Properties of Raw Cotton' in 1915, and not his earlier view first published in 'The Cotton Plant in Egypt' in 1915, and reprinted in 1919. The mistake arose through my assuming that the 1919 reprint gave a later view than the 1915 publication."

PERSONAL NOTES

We much regret to announce the death in January last of two members of the Empire Cotton Growing Corporation:

Mr. J. Compton, M.P., a co-opted member of the Administrative Council for some years.

Mr. R. Houghton, a representative of the Cotton Spinners' and Manufacturers' Association on the Council of the Corporation.

We tender our sincere congratulations to the following members of the Administrative Council of the Corporation, whose names appeared in the New Year's Honours List: Sir William Clare Lees, on the Baronetcy conferred on him; Sir Frank Stockdale, on receiving the honour of K.C.M.G.; and Sir Robert Waddington, on receiving the honour of Knighthood. Our congratulations are also extended to Mr. R. I. Campbell, M.P., and to Mr. E. J. Turner, on whom the honour of C.B. was conferred.

APPOINTMENTS.

West Indies.

Mr. J. B. Hutchinson has been appointed Head of the Genetics Department of the Cotton Research Station, Trinidad.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing the following officers are on leave in this country from cotton-growing countries:

British Guiana	Prof. J. S. Dash.
Gambia	Mr. L. H. Saunders.
Gold Coast	Mr. A. Jones.
„ „	Mr. A. C. Miles.
„ „	Mr. H. Nicholas.
„ „	Mr. C. L. Willding-Jones.
Nigeria	Mr. V. F. O. Olivier.
„	Mr. J. D. Tallantire.
„	Mr. A. E. Trotman.
„	Mr. J. M. S. Usher-Wilson.
Nyasaland	Mr. F. Barker.
Tanganyika Territory	Mr. P. W. Briggs.
„ „	Mr. J. V. R. Brown.
„ „	Mr. F. W. Thomas.
„ „	Mr. D. Thornton.
„ „	Mr. A. J. Wakefield.
Uganda	Mr. D. S. Davies.
„	Mr. H. R. Hosking.
„	Mr. R. K. Kerkham.
„	Mr. T. McEwen.

The following officers of the Corporation's staff abroad are on leave in this country:

Nigeria	Mr. G. Browne.
Nyasaland	Mr. W. L. Miller.
South Africa	Mr. W. L. Fielding.
„ „	Mr. J. Marshall.
Southern Rhodesia	Mr. A. N. Prentice.
Sudan	Mr. R. R. Anson.
„	Mr. T. Trought.
West Indies: *St. Vincent*	Mr. S. H. Evelyn.
„ „ *Trinidad*	Mr. J. B. Hutchinson.

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher

EMPIRE COTTON GROWING CORPORATION

King's Buildings, Dean Stanley St., Millbank, London, S.W. 1

List of Publications issued to date. Those still in print can be obtained direct from the Corporation at the above address. Those out of print are marked with an asterisk. The prices include postage.

GENERAL AND TERRITORIAL

"Cotton Growing within the British Empire and The World's Capacity for Consuming Cotton Goods." J. W. McConnel. 1921. Price **2s.**

"Cotton Growing in Nigeria." Sir Hector Duff. Price **2s.**

"The Extension of Cotton Cultivation in Tanganyika Territory." Major Hastings Horne. 1922. Price **2s.**

★ "Cotton Cultivation in Nyasaland." H. C. Sampson. 1922.

"Cotton Growing in South Africa." G. F. Keatinge. 1923. Price **2s.**

★ "Cotton Growing within the British Empire." L. G. Killby. 1924.

"A Cotton Research Station for the British Empire." Professor J. B. Farmer and Mr. L. G. Killby. 1925. Price **2s.**

"Report on the Cotton-Growing Industry in Uganda, Kenya, and the Mwanza District of Tanganyika." Col. C. N. French. 1925. Price **1s. 3d.**

"Memorandum by the Mechanical Transport Sub-Committee." Mr. G. H. Baillie, Mr. R. H. Brackenbury, Col. C. N. French. 1925. Price **2s.**

"Report on the Cotton-Growing Industry of Nigeria, 1926." Col. C. N. French. 1926. Price **2s.**

★ "The Principles and Practice of Yield Trials." F. L. Engledow and G. Udny Yule. 1926.

"Report on Suitable Rotation Crops for Cotton." H. C. Sampson. 1927. Price **1s.**

"Cotton Growing in Southern Africa and the Rhodesias." Report on a Tour undertaken by Sir James Currie, Mr. J. S. Addison, and Mr. H. C. Jefferys. 1927. Price **2s.**

★ "Reports from Turkestan Plant Breeding Station, Tashkent." 1928.

"Review of the Situation in the Principal Cotton-Growing Territories of the Empire, and a Summary of the Main Activities of the Corporation since their Formation." 1928. Price **9d.**

★ Out of print.

"Report on Cotton Breeding and Seed Supply in Nigeria, 1928." F. L. Engledow and C. N. French. Price **2s.**

"Conference of Workers on Cotton Growing Problems, held August, 1930." Papers and Discussions. Price **2s. 6d.**

"Conference of Workers on Cotton Growing Problems, held July 1934." Papers and Discussions. Price **2s. 6d.**

"The Principles and Practice of Field Experimentation." J. Wishart and H. G. Sanders. 1935. Price **3s.**

REPORTS RECEIVED FROM EXPERIMENT STATIONS

Seasons 1923, 1924 and (South Africa only) 1925. Price **2s.** The following volumes are obtainable at **2s. 6d.** each: Season 1925-26, 1926-27, 1931-32, 1932-33, 1933-34, 1934-35, 1935-36. The remaining volumes are now out of print.

REVIEW OF THE WORK OF THE EXPERIMENT STATIONS

Season 1933-34, J. C. Willis; 1934-35, J. C. Willis; 1935-36, W. Nowell. Price **1s. 6d.** each.

MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD

Price **2s. 6d.** each.

Series A : Genetics.

No. 1. The Inheritance of (i) Petal Spot, (ii) Pollen Colour, (iii) Corolla Colour. S. C. Harland. 1929.

★ **No. 2.** Studies on the Inheritance of Corolla Colour and Petal Size in Asiatic Cottons. J. B. Hutchinson. 1931.

★ **No. 3.** (*a*) Reversal of Dominance in the Interspecific Cross *G. barbadense* Linn. x *G. hirsutum* Linn. and its Bearing on Fisher's Theory of Dominance. (*b*) The Inheritance of Chlorophyll Deficiency in New World Cottons. S. C. Harland. (*c*) "Crumpled." A New Dominant in Asiatic Cottons produced by Complementary Factors. J. B. Hutchinson. 1932.

No. 4. The Inheritance of Anthocyanin Pigmentation in Asiatic Cottons. J. B. Hutchinson. 1933.

No. 5. The Mitosis and Meiosis in Diploid and Triploid Asiatic Cotton. A. Skovsted. 1933.

No. 6. (*a*) Further Experiments on the Inheritance of the Crinkled Dwarf Mutant of *G. barbadense.* S. C. Harland. (*b*) Two Interspecific Hybrids between Asiatic and New World Cottons. A. Skovsted. 1934.

★ Out of print.

No. 7. The Inheritance of Leaf Shape in Asiatic *Gossypiums.* J. B. Hutchinson. 1934.

No. 8. Further Experiments on the Inheritance of Chlorophyll Deficiency in New World Cottons. S. C. Harland. 1934.

No. 9. (*a*) Some New Interspecific Hybrids in the Genus *Gossypium* L. (*b*) A Hybrid between *G. Davidsonii* and *G. Sturtii.* A. Skovsted. 1935.

No. 10. (*a*) Homologous Genes for Anthocyanin Pigmentation in New and Old World Cottons. (*b*) A Third Series of Experiments with the Crinkled Dwarf Mutant *G. barbadense* L.—The Cross *barbadense* crinkled × *hirsutum* crinkled. (*c*) The Inheritance of Brown Lint in New World Cottons. S. C. Harland. 1935.

No. 11. Chromosome Numbers in the Malvaceæ. I. A. Skovsted. 1935.

No. 12. The Inheritance of Fuzz and Lintlessness and Associated Characters in Asiatic Cottons. J. B. Hutchinson. 1935.

No. 13. Some Observations on the Inheritance of Form and Size in Asiatic Cottons. J. B. Hutchinson. 1936.

No. 14. Chromosome Conjugation in Interspecific Hybrids. A. Skovsted. 1937.

Series B : Physiology.

★ **No. 1.** Studies on the Transport of Carbohydrates in the Cotton Plant. Parts I. and II. T. G. Mason and E. J. Maskell. 1928.

★ **No. 2.** Studies on the Transport of Nitrogenous Substances in the Cotton Plant. Parts I., II. and III. E J. Maskell and T. G. Mason. 1930.

No. 3. Studies on the Transport of Nitrogenous Substances in the Cotton Plant. IV. The Interpretation of the Effects of Ringing, with special reference to the Lability of the Nitrogen Compounds of the Bark. V. Movement to the Boll. E. J. Maskell and T. G. Mason. 1930.

No. 4. Studies on the Transport of Carbohydrates in the Cotton Plant. III. The Polar Distribution of Sugar in the Foliage Leaf. E. Phillis and T. G. Mason. 1933.

No. 5. Further Studies on Transport in the Cotton Plant. I. Preliminary Observations on the Transport of Phosphorus, Potassium and Calcium. II. An Ontogenetic Study of Concentrations and Vertical Gradients. T. G. Mason and E. J. Maskell. 1934.

No. 6. Studies on the Transport of Nitrogenous Substances in the Cotton Plant. VI. Concerning Storage in the Bark. T. G. Mason and E. Phillis. 1934.

★Out of print.

No. 7. Further Studies on Transport in the Cotton Plant. III. Concerning the Independence of Solute Movement in the Phloem. T. G. Mason, E. J. Maskell and E. Phillis. IV. On the Simultaneous Movement of Solutes in Opposite Directions through the Phloem. E. Phillis and T. G. Mason. 1936.

No. 8. Further Studies on Transport in the Cotton Plant. V. Oxygen Supply and the Activation of Diffusion. T. G. Mason and E. Phillis. Concentration of Solutes in Sap and Tissue, and the Estimation of Bound Water. T. G. Mason and E. Phillis. 1936.

No. 9. Further Studies on Transport in the Cotton Plant. VI. Interchange between the Tissues of the Corolla. E. Phillis and T. G. Mason. 1936.

No. 10. The Effect of Light and of Oxygen on the Uptake of Sugar by the Foliage Leaf. E. Phillis and T. G. Mason. 1937.

EMPIRE COTTON GROWING REVIEW

The official journal of the Corporation is published quarterly by Messrs. P. S. KING AND SON LTD., 14, Great Smith Street, London, S.W. 1, to whom application should be made for copies, and not to the Corporation. Annual subscription, 5s. post free.

SIR JAMES CURRIE.

THE
EMPIRE COTTON GROWING
REVIEW

VOL. XIV. JULY, 1937. No. 3

SIR JAMES CURRIE

BY

J. C. MAY AND L. G. KILLBY

LATE in 1920 the Empire Cotton Growing Committee met at the Board of Trade to select a Director of the Corporation that was to be brought into being to carry out their recommendations. From the summaries of the careers of the well-known men who had applied, the Chairman extracted that setting out the qualifications of the candidate about to be interviewed:

> " Sir James Currie, K.B.E., C.M.G.; born 1868. Fettes, open scholar, Rugby XV., Cricket XI. Edinburgh University, exhibitioner. Lincoln College, Oxford, scholar; M.A. Represented Oxford *v.* Cambridge at golf, 1889.
>
> Principal, Gordon College, Khartoum, and Director of Education, Anglo-Egyptian Sudan, 1900-14. Member of Governor-General's Council, 1910-14. Twice acted as Governor of a Province.
>
> Director of Training of Munition Workers, Ministry of Munitions, 1916-18, and since, Controller, Industrial Training Department, Ministry of Labour."

One of the present writers was instructed to summon the candidate. A striking figure entered. A powerful body and a fine head covered with iron grey hair gave an immediate impression of great force of character. Questions usual in such circumstances were asked and answered, and then came one final query from the candidate that was typical of the man and of his desire for freedom of action and responsibility: " Will expenditure be strictly controlled from year to year as in Government Departments, or will there be some measure of elasticity ?" This was accompanied by a laugh that showed that he bore Government methods of finance no ill-will, but evidently had a feeling that an inelastic system was in this case calculated to shackle action, especially in work that was likely to expand. Reassured on this point the candidate left, and as he closed the door the members of the Committee knew that they had found the man for whom they had been looking.

Sir James Currie took up his duties as Director of the Corporation in June, 1921, and there followed nearly sixteen years of strenuous work. It is of those years that we write; others have described, elsewhere, his magnificent work in the Sudan. His breadth of vision, his refusal to be hurried in the hope of achieving spectacular results which might well have lacked permanence, and his charm of manner which brought him so wide a circle of friends and acquaintances and made them always ready to do whatever they could for him, were all invaluable to the Corporation.

One of the first needs was a staff of expert agriculturists. The Indian Agricultural Service could be drawn upon for a few senior men without unduly hampering its activities, but it was obvious that not only did the Corporation need a number of well-trained young men, but that many of the Colonial Agricultural Departments were sadly understaffed, and that the standard of training must be raised. Advice was therefore needed on the selection and training of men: nothing would satisfy Sir James except the foremost advisers in this sphere of education. Obviously such men would be extremely busy, but he was convinced that they would listen to his appeal, and such were his powers of persuasion that all the distinguished scientists whom he approached joined Dr. W. L. Balls, who had already rendered so much help to the Board of Trade Committee, as members of the Corporation's Research and Training Sub-Committee. Among the results of their work were (1) a Studentship Scheme, under which special training has been provided for more than eighty men, almost all of whom have passed into the Corporation's service or into the Agricultural staffs of the Empire, and (2) a Research Station in Trinidad where valuable work is being done on the fundamental problems of cotton.

The West Indian Agricultural College, which later became the Imperial College of Tropical Agriculture, was in process of being established in Trinidad at this time, and Sir James threw himself heart and soul into the task as a member of the Governing Body in 1922, and from 1927 onwards as its Chairman. Realising the possibilities the College possessed of rendering invaluable assistance to the agricultural services of the Empire as a whole, he lost no opportunity of urging its claims for support not only on the Empire

Cotton Growing Corporation but on all bodies and persons from whom help was likely to be forthcoming. At the College almost all the Corporation's post-graduate Students and those of the Colonial Office have spent their second year's specialized training, gaining an insight into tropical crops under expert supervision before proceeding to take up their appointments. The results have been a widening of outlook, an awakening to possibilities and the formation of an *esprit de corps* throughout the whole of the Colonial Agricultural Departments. It is indeed to the results of the training given by the College that is due a large measure of the progress that the Corporation are able to record.

Gradually the cotton-growing areas were provided with a network of Experiment Stations, either staffed by the Corporation or, in some cases, assisted by it financially. The jassid-resistant cotton bred at Barberton has spread, season by season, over other areas in Africa. A leafcurl-resistant strain has been multiplied in the Sudan: steadily the amount of cotton produced in the Empire (excluding India) increased from little more than one hundred thousand bales in 1921 to three-quarters of a million bales in 1936. Who can assess the extent to which this progress was due to that forceful character that assisted the Corporation's Executive Committee to direct its policy, that encouraged and helped so many of those responsible for the Empire's agriculture? In recent years scientific workers in the tropics have found that their work has been increasingly receiving a wider intellectual appreciation. But Sir James gave them more, for he added a warm human sympathy.

In many directions results have been obtained that at one time appeared remote indeed, and their achievement owes much to Sir James's patience and perseverance; never discouraged himself, he stimulated those with whom he worked until in time his objective was almost invariably attained. The debt owed by general Colonial development to his inspiration and criticism, the latter sometimes trenchant but nevertheless invariably accompanied by constructive suggestions, was recognized by his promotion to K.C.M.G. in 1933.

As the years passed the Corporation's policy became more clearly defined and Sir James was able to give time to other public work having in one way or another a bearing on the Corporation's activities—the Chairmanship of the Oversea Mechanical Transport Directing Committee and of the Scholarship Committee of the Kitchener Memorial Fund, membership of the Colonial Office Advisory Committee on Native Education, of a Committee of enquiry into agricultural education in Great Britain, of the Governing Bodies of the Imperial College of Science and Technology and Marlborough College, and the Chairmanship of the Governors of Dauntsey's School in Wiltshire.

And so we come to the day of his sudden death at Cambridge, where he had gone to attend a meeting of a Committee on Veterinary teaching. Working, and not in retirement, Sir James died as he would have wished. Full of mature experience, his gifts of intellect and driving power were undiminished, his zest in life unabated, and his interest in men and affairs as keen as ever. We who write this worked in daily contact with him for sixteen years; we mourn not only a chief, but a much loved friend. That this feeling is shared not only by all members of the Corporation's staff at home and abroad, but by a very large number of others, is the theme of all the numerous letters that have reached the Headquarters Office from all parts of the world.

SOME COTTON PROBLEMS OF SOUTH AFRICA

BY

S. MILLIGAN, C.B.E.

THE writing of the following note has been suggested from a perusal of the Annual Reports from Empire Cotton Stations, published by the Empire Cotton Growing Corporation. Those who have followed the activities of this body, whose main objective may be stated as being the improvement of the status of the Empire crop, will have noticed an increasing tendency towards the study of the purely biological aspects of cotton-growing, for although other factors in production such as farm economy, ginning, transport and marketing are of great importance, these are now in the main in an advanced state of organization owing to the efforts of local Administrations and the growers themselves, to the " trade," and last, but not least, to the activities of the British Cotton Growing Association.

In the study of the problems involved decentralization has been adopted as a first principle, and so we find that, apart from the more intensive research in progress at the Cotton Station, Trinidad, investigations in which the Corporation is concerned are largely of an " ad hoc " character, conducted either by its own staff at its own Stations or through assisted Government institutions of a similar character. The large measure of success which has followed this sound and practical method of approach may be attributed to two advantages inherent in decentralization as an initial policy—viz., the accumulation of a knowledge of local conditions and a realization, through experience, of the key problems requiring solution. The steady increases in acre yields recorded in the Annual Reports are in themselves an indication of the effects not only of improved varieties but of a better understanding of how the crop can be grown to the greatest advantage in the conditions prevailing at each centre. In spite of its many advantages decentralization can, however, obviously lose much of its value unless accompanied by a considerable amount of collaboration between Stations and, in addition, by some form of co-ordination, as the very limitation of individual staffs limits the scope of the work. This is especially so when it comes to the study of some of the wider problems. It seems inevitable that once the purely local questions have been settled, either more centralization or greatly increased collaboration amongst groups of Stations possessing similar major problems will be found necessary. This principle has already been in operation for some years so far as the Corporation's Stations are concerned. It is, however, not the purpose of this note to discuss the trend of future policy but to illustrate the advantages of that already in force—viz., a concentration on local problems as a necessary preliminary to what is hoped will be a more or less complete study of the subject. The author is compelled, from want of space, to confine himself to one part of the African Continent—viz., the Union of South Africa—and of one part of that country—viz., the low veld—but the character of the investigations conducted there may be taken as representative of what has been adopted in other places.

The areas in which cotton has been grown in the Union of South Africa during the last fifteen years may be divided roughly into two divisions—viz., those lying respectively to the east and west of the Drakensberg—their main difference in character, so far as this crop is concerned, being due to altitude directly affecting the length of the growing season, for, although various types of soil occur, the plant appears to grow well enough on most of them. On the plateau to the west of the escarpment crops are liable to suffer from early frosts from the end of April onwards, but such are rarely experienced in the eastern low veld for at least another month, an advantage which is, however, offset in the more eastern part of this tract by the prevalence of the cotton stainer bug, affecting, as it does, the later set bolls. Both, however, would have a season long enough for cotton were it not for bollworm pests. In the western area the problem is almost entirely one of "bollworm"; in the eastern parts of the low veld it is bollworm-cum-stainer, but the removal of one would, owing to the longer growing season, probably leave sufficient manœuvring room in which to avoid the other. It is thus not to be wondered at that the abandonment of cotton-growing, after the fall in prices, occurred mainly in the western and extreme eastern areas, and that what remains lies in that part of the low veld less subject to stainer attacks—viz., the land lying immediately to the east of the Drakensberg.

This area would also have disappeared from the cotton map but for the timely discovery of an all-round satisfactory plant resistant to jassid, attacks of which coupled with bollworm infestation had reduced yields to a point below the cost of production. This question has been solved through plant selection, and the area in question has been thus rendered fairly safe for cotton-growing in spite of bollworm. A splitting of the bollworm-stainer combination would probably do the same for large stretches lying further to the east.

Insect problems thus occupy a dominating position in South Africa, as they do in nearly all cotton-growing countries. The Empire Cotton Growing Corporation's main Station at Barberton and subsidiaries at Bremersdorp and Magut were established in the year 1925. The danger to the crop from jassid, bollworm, and stainer pests was early recognized. Jassid received first attention owing to the urgency of the question and the possibility of dealing with it through plant breeding, but the other two groups have all along presented a more serious problem, as at present there appears little hope of employing this agency in any direct capacity.

The subject of plant breeding has been fully referred to in the Station Reports, mainly in connection with the jassid pest, but it should be noted that relief from jassid attack would in itself have been insufficient to preserve cotton-growing during the period of low prices. Other qualities, such as earliness and drought resistance, were urgently required in face of other insect pests and prolonged spells of dry weather. The strain finally chosen was by no means the most "jassid-resistant" of those examined. Such were mainly to be found amongst the later and poorer yielders. A compromise had thus to be effected, and this was found in the high yielding U.4, which although less resistant than some others, gave on extended trials over 40 per cent. more crop than its nearest rival, an increment in yield which may fairly be put down to three main characters which it possessed in a high degree: (1) earliness and rapidity in flowering and re-setting of bolls after a setback; (2) prolificness; (3) low rate of "shedding."

The general advantage of an early variety for the later plantings in areas where good seeding conditions do not last for long after rain, and where plantings are often delayed, soon became apparent. Early flowering also proved advantageous in the lower and more fertile fields which tend to produce overgrowth with its accompanying disadvantages, if the plants are not checked by fruiting. There is, however, a limit to earliness so far as the poorer soils are concerned, unless combined with considerable structural strength in the plant itself, as its inhibitive influence on growth tends to produce crops too small to give maximum possible yields in such conditions. Much of the re-selection work of recent years at the Barberton Station has indeed been devoted (with considerable success) to the improvement of the earlier strains in this direction. Of even greater importance in an area where drought and bollworm attack are of frequent occurrence was the faculty inherent in the U.4 strains of making rapid response in flowering once improved conditions set in. Not infrequently have fields practically denuded of both bolls and flowers by American bollworm recovered to such an extent as to produce a final yield of as much as 1,000 lbs. per acre of seed cotton.

As a compensation for the relatively small size of boll, the U.4 parent variety and its derivatives are extremely prolific in flowering. This, again, is a feature of considerable value in contending with bollworms, especially in the case of the slower moving Sudan species, often enabling the plant to keep ahead of the pest in favourable growing conditions and to preserve a balance of crop, while the larger bolled and less prolific types may be completely submerged. As one enthusiastic grower put it, "For every flower taken, the plant appears to set two new buds!"

Retention of bolls during drought was also very marked. This is a most valuable character, as ability to do so even for a few days longer may make just all the difference in the final result. Cases were observed during the earlier days of the breeding work at Barberton, before any extensive elimination of undesirable varieties had been effected, of one variety having lost nearly all its crop through shedding while another retained it sufficiently long to be saved by a timely shower. Another feature of most of the U.4 derivatives is the marked power of retention of the cotton in the boll after opening. Although this is of much less importance than the others, it has time after time proved of great value during picking operations in the more extensive holdings in saving loss of crop on the ground.

Such are some of the additional qualities in the make-up of this variety which largely influenced its selection and have contributed to its success as a parent both in its own locality and further afield. Agricultural problems may now be considered.

Of these first place must be given to soil fertility without which maximum outturns are impossible of attainment in a favourable season, and without which even the most suitable type of plant is apt to make bad weather in difficult conditions. The majority of the soils in the area we are considering appear to be particularly well suited to cotton, and while the highest recorded outturns (up to 2,200 lbs. of seed cotton per acre) have all been obtained from the lower lying fields which occasionally receive heavy dressings of organic manures applied to such crops as tobacco, maize and vegetables, the 1,500 lb. mark has been frequently reached on higher lands in a fair but not excessive state of fertility. Although a considerable amount of work has been done on the subject, rapid results have not been aimed at, but the remarkable yields through the use of nitrate of soda referred to in last year's Report on the (apparently) poorish granite soil on an outlying part of the Barberton Station have drawn attention to what might readily be attained on this class of land. Indeed, there is good evidence on all sides of the possibility of a still further increase in acreage yield on many fields which at present produce fair, but nevertheless well below potential outturns.

In addition to its necessity for maximum yields, two important "protective" influences of soil fertility may be mentioned—viz., the shortening of the critical cotyledon period through quicker early growth, and, later on, the stimulation of recovery after drought or insect attack. Land in good condition may thus be confidently expected not only to produce better, but safer, crops. There is, however, an upper limit, conditioned by local circumstances, beyond which artificial fertility cannot safely be pushed. In dry areas, for example, it may prove dangerous to over-stimulate a crop when young, lest, later on, the available soil moisture may prove insufficient for a too-heavy growth, and such has also to be avoided in the lower lying and moister areas for obvious reasons. But while it is well to remember that there is such a thing as a proper ratio between manuring and soil moisture, the very extent of the dry areas renders them safe from being over-fertilized.

The improvement of the fertility of the soil on extensive outlying areas is by no means an easy matter in a locality where few cattle are kept over and above those required for draught purposes, and where all available farmyard manure is needed for the more valuable but less hardy crops, such as fruit, vegetables and tobacco. At best it is a slow business, involving a conservative style of farming, and the avoidance, as far as possible, of practices operating in the opposite direction.

In South Africa, however, the first consideration should be the protection of the soil against rain wash. Soil erosion is indeed a pressing problem in many parts of Africa—in fact, the most urgent of all agricultural problems—and the best dry land cotton areas are all subject to it in varying degrees. Although complete protection is not quite so easy as might appear, owing to the difficulty of disposing of surplus water during floods, much can be done by farmers themselves to save both their outlying and lower lands from denudation. The main area in the Barberton Station has been protected by an elaborate system of open drains, but the outlying area (already referred to as having given a remarkably high yield for the class of soil) has been greatly improved through contour banking, and it is hoped that a realization of the value of the upper lands for cotton-growing will lead to a general improvement in this direction in the districts.

The first step, then, is to conserve what you have, and the next to improve it if possible. This, we find, has received attention at all Stations, although little specific mention is to be found in the Annual Reports. The shortage of farmyard manure has been referred to. Green manuring entails the sacrifice of a crop, and it is doubtful if this practice could be carried out at sufficiently close intervals to have any marked effect. Rotations have occupied a prominent place in the programme of work, and the utilization of crop residues through composting is being taken up. The use of non-edible oil cake—*e.g.*, castor cake—and the substitution of bone meal for part of the superphosphates at present used would also tend towards a more permanent fertility of the soil. The matter is certainly one which will repay the money and effort now being spent on it.

The above remarks apply mainly to the maintenance and improvement of soil fertility from the more permanent point of view. Next to be mentioned is the question of cultivation as affecting the immediate needs of the plant as regards moisture, available nutrients, etc.

The main consideration here is that of moisture at planting time. This in dry areas is always one of great importance, and in the case of cotton-growing in the South African low veld it is especially so. Experience goes to show that, within limits, the earlier planting is begun the better, if destruction of the later crop through stainer is to be avoided. Rains are required before seeding: they are uncertain, and, in addition, it is seldom possible to plant all the crop after one wet spell owing to the rapid drying out of the surface. The difference in germination and early growth between one day's planting and the next has to be seen to be believed.

In this connection two considerations force themselves on our attention—viz., the necessity of preserving as far as possible residual subsoil moisture from the previous crop, and the utilization to the full of pre-planting rains, for the top moisture has to join up with that lower down before the seeding of the crop can be considered safe. From the point of view of both, contouring is very desirable as delay of the run-off is the most important factor of all, so far as soil moisture is concerned.

Another approach is being investigated—viz., that of the effects of various crops on residual moisture. The rotation experiments, if they have done nothing else, have shown quite considerable differences in this respect between such crops as maize, soya beans and sunflower on the one hand, and tepary beans on the other. Fodder crops for winter feeding would be ideal, as they would be cut well before the land had dried up, but the scale on which they can be grown is limited by the extent to which mixed farming can be practised. Attempts have been made at the Cotton Stations to secure good moisture conditions through bare fallows, but while these have been successful in their primary objective, results have been almost completely nullified by the poor growth on the part of the succeeding crop in its early stages. Besides, bare fallows are inadvisable on sloping lands, owing to great liability to wash. More immediate results are thus likely to lie in the construction of anti-erosion contour banks.

As regards surface moisture for the planting season, efforts are usually made to have as much ploughing done as is possible well in advance, so as to make full use of the first spring rains. The position as regards this in the districts is capable of improvement. There is usually some rain in the winter months, but this generally comes in one spell and is insufficient for ploughing more than a relatively small portion of the arable area. Much greater advantage could be taken of such opportunities by the increased use of tractors. These with their weighty ploughing equipment can be used for longer spells than cattle, which, as may be imagined, are in none too good condition for heavy work towards the end of the dry season. The Barberton Station, for example, since the change over to tractors, has little difficulty in ploughing up all its arable area well ahead of planting time, but whether it would be economically sound to keep additional machines for this purpose for a purely commercial area is another matter. Ploughing by oxen immediately after harvest, as is the common practice in Rhodesia, might be a possibility in the Union after a crop non-exhaustive as to moisture, such as tepary beans —indeed, any measure to preserve subsoil moisture will tend to facilitate this.

Space does not permit of anything but a brief reference to soil preparation and treatment of the crop subsequent to planting. Normally, where due attention has been paid to soil fertility and conservation of moisture, the production of a favourable seed bed and of a strong seedling follow as a matter of course. One point with regard to " tilth " is probably worth mentioning. A fine surface is not necessary for large seeded crops such as cotton —indeed, instances have been seen where such has proved a disadvantage, especially in wind storms where a friendly clod may give all the shelter required by a seedling.

Spacing of plants may in certain circumstances assume great importance. The closer spacings have in general given the highest yields in the plot experiments, but instances have been observed of the danger of going to extremes in this direction, as recovery after drought and bollworm attack is much less certain with very close spacing. In this connection the experience of a cotton-grower in the Barberton area is interesting. From the beginning he has almost invariably had an annual visitation from American bollworm, and has suffered severely. Of recent years he has adopted the practice of hand planting at intervals of a yard each way between plants with a view to cross row intercultivation, and this has facilitated recovery to such an extent that good crops from subsequent settings are now the rule. On the other hand, in places where the normal season is so short as to preclude any chance of reaping a late crop, everything points to close spacing in order to increase the yield from the earlier flowers. The same remark applies to late plantings and for the same reason. A good rule appears to be to close up the intervals in the rows as the planting season advances.

Reference has been made to the study of rotation crops from the point of view both of residual soil moisture and soil fertility. They have of more recent years assumed a new importance in their bearing on the American bollworm problem, many of them being alternative hosts of this pest. From the investigations, which are in an early stage, it would appear likely that through judicious "timing," rotation crops can be used as counter attractives, diverting at least part of the attack from cotton in place of acting as mere breeding-grounds —an important advance, especially in those areas where the latter crop is the first consideration.

Such, then, are some of the problems which have been under investigation at a Station where insect attack is a first consideration. Some of them have been successfully dealt with, and the results obtained put into practice locally, thus preserving a useful nucleus of cotton-growing when the time arrives for expansion. The breeding work has in addition supplied material for use in South and East Africa, and the preliminary investigations on insect pests have led to the employment of a special staff to study two of the groups over a wide field, in the hope that ultimately extensive areas may be freed from their present disabilities so far as cotton-growing is concerned.

Received May, 1937.

COTTON GROWING AND BREEDING IN THE ANGLO-EGYPTIAN SUDAN

BY

TREVOR TROUGHT

Asst. Director, Agricultural Research Service, Sudan.

THE early history of cotton in the Sudan, as distinct from Egypt, requires no more than a general reference. It is undoubted that wild and cultivated or semi-cultivated cottons have existed in the country from very early days, but it is not until quite recently that records have been more than sporadic. Dudgeon* mentions a reference by Pliny to cotton growing in the Sudan, discusses at some length the "Sennar tree cotton," and suggests that a type described by Veslingius in 1592 was *G. vitifolium*, which had been introduced to Egypt from Central Africa through the Sudan, and had been established since remote times, or was possibly indigenous. Coming to recent times, Fleming† notes that a Turkish pasha, Ahmed Mumtaz, was the founder of the Tokar cotton industry some time between 1850 and 1860, though this industry came almost to a standstill during the Dervish rule.

During the early years of this century the official "Reports on the Finance, Administration and Condition of the Sudan" make interesting reading, and show that there was considerable interest taken in cotton growing and the introduction of varieties from abroad, particularly from Egypt. The following notes, taken more or less at random from these early reports or from the reports of what was then the Department of Agriculture and Lands, are indicative of this interest.

In 1904 Ashmouni, Mitafifi and Abbassi seed was distributed from Dongola to Kordofan. Results were considered encouraging, but there was difficulty in inducing villagers to cultivate properly. The American Mission on the Sobat grew Mitafifi *as a rain crop.* A sample of cotton sent in by Captain Lloyd from the Niam Niam country appeared much like Peruvian Kidney. In 1905 knowledge was acquired that Egyptian cotton could be grown with reasonable chance of success in most parts of the Sudan. The Governor, Blue Nile Province, said " Real progress in cotton cultivation will have to wait for those who will water the land by means of pumping machinery or canals."

---

* G. C. Dudgeon: "Bulletin No. 3A, Egyptian Agricultural Products. Gossypium Spp." 1916. Cairo Government Press. See also p. 14 of Watts' "Wild and Cultivated Cottons of the World."

† G. J. Fleming: "Tokar," Sudan Notes and Records, vol. iii., No. 1.

The Governor, Singa, held a small cotton exhibition in 1906. There was a very good crop at Tokar, and cotton planters in Khartum Province were importing their own seed from Egypt. The Sudan Government Museum Report for this year records the occurrence of wild cotton near Bor, at Khor Attar (White Nile) and near the mouth of the Bahr El Arab. Also that *G. hirsutum* was cultivated by the Golos in the Bahr El Ghazal and *G. purpurascens* (*Kutn Arabi*) at Sennar. It was suggested that the latter cotton was probably the same as Mumtaz cotton, said to have been introduced from Egypt about fifty years previously. It was early in this year that Mr. Leigh Hunt disposed of his concession of 10,000 feddans at Zeidab to the Sudan Plantations Syndicate, who sowed their first crop of 100 feddans of cotton.

In Kassala the cultivation of cotton in 1907 was reported to be easy. " The natives simply remove a piece of the cracked soil left after the flood has subsided, and the seed is planted a few inches below the surface. There remains nothing to do except to thin the plants, as hoeing is not possible on this land, and would do no good if it were." In the White Nile the sowing of Egyptian cotton was getting more popular in the Dueim district; and some of the natives planted cotton in rows. In this year, the Sudan Plantations Syndicate had 1,130 feddans of cotton at Zeidab. The following is an extract from the 1908 report: " There seems no reason to doubt that Egyptian cotton of the best qualities can be produced on artificially irrigated riverain lands . . . but experience and experiment have yet to decide many points; for example, what is the best date for sowing. There is as yet no unanimity among growers on these points and it can hardly be expected for several years to come."

In 1909 Egypt increased the allowance of perennial irrigated land from 10,000 to 20,000 feddans. A prominent Sheikh of Managil made a successful attempt to grow Egyptian cotton as a rain crop. Tokar cotton had a market in Egypt, but was used for mixing with Egyptian cotton because it had not " sufficient reputation of its own." The question of a " Gezira Irrigation Scheme " is mentioned for the first time.

At the Central Research Farm, Shambat, the crop, although giving a record yield, suffered from what was almost certainly, from the described symptoms, a bad blackarm attack,* and a note was made that there were considerable numbers of bollworm present in February. Were these pink bollworm ?

The following year there was a large increase in the cotton area and a record Tokar crop (98,000 kantars valued at £145,000). This was the first year when a uniform variety was grown all over the Tokar delta. In 1911 there were 73 gins in the Sudan. It was suggested that Government should exercise control of import of cotton seed, ginning and grading. Mr. W. A. Davie wrote: " Notes on Growth of Cotton in the Sudan." The Taiyiba Experimental Scheme was taken over by the Sudan Plantations Syndicate on April 9, 1911.

The reports make no mention of " plant breeding " as understood today, but the above notes show that an intense interest was taken in cotton and that the germs of many present problems were in existence then.

In 1912 Mr. R. E. Massey was appointed to the post of Economic Botanist on the Central Research Farm at Shambat, and included cotton-breeding among his very numerous duties. He started on the purification of existing strains of Egyptian cotton—principally Afifi and Assili. Later his selection work was extended to Sakel, and a considerable amount of work was done on American cottons—of which a wide range was introduced from the United States.

About 1923, Mr. A. R. Lambert (who was appointed an Inspector of Agriculture in the Department of Agriculture and Forests), taking Massey's Sakel selection " No. 186 " as the basis, started selection work on cotton " on his own " and in his spare time; this work will be referred to later.

With the first big extension of the irrigated area in the Gezira in 1925, consequent on the opening of the Sennar Dam, in order to free Mr. Massey for intensive work on blackarm and other diseases, it was decided to divide up the work and recruit a specialist to take charge of the plant-breeding work. Mr. M. A. Bailey was appointed in 1925, and with his appointment the Plant Breeding Section was established, and plant-breeding work became a recognized form of Government research activity. In view of the importance of cotton to the Sudan, breeding work has been confined largely to cotton.

A general knowledge of the conditions and background of the work will be familiar to readers of this journal from numerous articles by different authors which have already been published.*

---

* The record says that the lower branches and leaves, together with the earliest formed bolls, withered and fell away, and by the end of October practically the only healthy vegetation left on many of the plants was a few branches and twigs at the top third of the bush giving the crop a weedy, spindly appearance, very different from the flourishing bushes which had existed a month previously. The earlier sown cotton suffered most.

The Plant Breeding Section was originally stationed at Shambat, near Khartoum, and had its experimental plots on the Shambat Research Farm, which was irrigated by pumping from the Nile. In 1935 the headquarters of the Section were moved to the Gezira Research Farm near Wad Medani, which is situated about the centre of the concession area of the Sudan Plantations Syndicate. The breeding of Egyptian type cottons is now carried out there. Work on American types was continued at Shambat until May, 1936, when a substation was opened at Kadugli, in the Nuba Mountains, to deal with the problems of the rain-grown cotton areas. Shambat is retained as a substation where the early stages of propagation of both Egyptian and American cottons are carried through.

The staff of the Plant Breeding Section now consists of five British officials and sixteen Sudanese Technical Assistants, together with the necessary complement of skilled and unskilled junior staff and labour. There is a small experimental ginnery at Shambat and another at the Gezira Research Farm. One is now required for Kadugli.

The activities of the Section fall naturally into two parts, (*a*) work on Egyptian types and (*b*) work on American types, and both parts have the same broad subdivisions of (i.) breeding work (selection, hybridization and introduction of new types), (ii.) testing of new types against a standard, and (iii.) propagation.

Each year a report on the work of the Section has appeared in the Empire Cotton Growing Corporation's publication "Reports from Experiment Stations" (latterly called "Progress Reports from Experiment Stations"). The Corporation has shown a great and practical interest in this cotton-breeding work from its inception, by monetary grants, or provision of staff.

With the foregoing in mind, what follows gives, briefly, a general review of the principles and broader outlines of the developments in cotton breeding which have taken place in the last ten or eleven years since the Plant Breeding Section came into being.

The three main *Egyptian* cotton areas at that time were the Gezira (free flow canal irrigation) the Gash Delta and the Tokar Delta (both under flood irrigation from the Gash and Baraka rivers respectively). Extensions to areas on the White Nile, under pump irrigation, have recently been made with success.

---

* See articles by Messrs. L. G. Killby, C. M. Hodgkinson, R. Hewison, R. E. Massey, L. Bluen, M. A. Bailey and F. W. Andrews in vols. i., ii., iii., vi., viii., ix., xi., and xiii.

The Gash and Tokar crops were not large, and varied with the area flooded from year to year, but they were established in the market and had high reputations for quality. They were practically " fancy " crops, and as such ticklish propositions to tackle from the plant-breeder's point of view. In the Gezira, however, it was recognized that reliance could not always be placed on Sakel to produce a satisfactory crop. Mr. Massey and Mr. Lambert had already been working to produce strains which would remedy this defect, and the importance of plant-breeding work was emphasized during the years following the large extensions to the Gezira cotton plantations which came after the opening of the Sennar Dam.

Testing, to compare *inter se* the existing strains and narrow down the possibilities, was the first step. Certain Sea Island introductions, made in 1921, had shown a vegetative vigour superior to that of Sakel, and further introductions were made in 1926, through the courtesy of Mr. L. H. Burd, from St. Vincent. Hybridization was employed with a view to combining the qualities of the two types, and much attention was paid to this aspect during subsequent years. The main defects of the Sea Island strains were " bad boll opening " and low ginning outturn. Constant selection has brought about a decided improvement in these respects. Work at the same time was continued with Massey's " Sakel 186 " and other Sakel, Upper Egyptian and Afifi strains. Further introductions, such as Tanguis, Fouadi, Garofallou, Giza 2, Giza 3, Giza 7, Sakha 4, Sakha 11 and other Giza strains were made from time to time.

The " Sakel 186 " strain by 1930 had been tested against other varieties on a field scale for five years and had generally been first in order of yield. Seed stocks of this type had been worked up, and it would, under normal conditions, have replaced the ordinary main crop Sakel in the Gezira. Unfortunately conditions were not normal. " Leaf curl " disease had appeared here and there in 1924-25, and in the 1928-29 season there was a general infection of the Gezira; the disease had also reached the Gash and Tokar deltas. " Sakel 186 " was found to be as susceptible to this disease as ordinary Sakel, so propagation of this strain was discontinued. Breeding work, with the advent of leaf curl, had to be directed to the discovery of a " leaf curl resistant " cotton. Much of the Sea Island material proved to be susceptible to the disease and had to be discarded, but fortunately there were individual plants and progenies which proved resistant. In 1928-29 a large number of new selections were made from Sakel with the sole object of obtaining resistant strains. It was in this year also that several small plots of bulked seed from selections made by Mr. Lambert in the Gezira were grown at Shambat. They were recorded by the section as LBAR types (Lambert's Black Arm Resistant). Certain of them differed somewhat from Sakel in habit, being more branched and leafy and, though later in maturing, were more prolific. These small bulks were not the produce of self-bred seed, and single plant selections were made from them. It was found that resistance to leaf curl was also present and propagation to bulk was commenced; the type now known as X1530 was so striking that its propagation was accelerated. This (with a sub-selection X1530A) is now grown on a large scale in the Gezira. Another selection from the same LBAR source (X1730) was less resistant to leaf curl, but a substrain (X1730A) seems to be satisfactory in this respect, and also to have a slightly enhanced yield and less rough lint. X1730A is expected to replace X1530 and X1530A.

The X1530 lint is a trifle rougher than Sakel, and as this proved to be a subject of comment by the graders, work has been directed to the improvement of its lint quality, as well as that of X1730, which was similar. (X1530A and X1730A were the first of these sub-selections.)

The yields of X1530 were so outstanding that it was possible to do wholesale discarding of many new strains which in themselves were improvements on the original Sakel standard, including some fixed "Sea Island × Sakel" hybrids which had a high degree of leaf-curl resistance and improved lint. The cotton breeder was faced with a radical alteration of the ideal to which he had to work.

The improvement of lint quality in the X1530 and X1730 types became, in fact, an object of first importance, while for those types with a finer lint, yields of the X1530 standard were required. Derivatives of the earlier Sea Island types showed promise, and work has been continued with these. Selections from a heavy yielding Sakel strain—originally sent in by the late Mr. Mann from the Gash Delta—are now exciting attention. This strain (known as NT/2) has lint of superior quality, a yield approaching X1530 and the most recent selections appear to have a sufficient resistance to leaf curl. Ishan was introduced from Nigeria and crossed with Sakel and Sea Island types in the hope of combining leaf curl resistance and good quality lint in the progenies.

While the work described above was in progress, another problem was also present which required solving. It had been hoped to control the bacterial disease "Blackarm,"* another of the major scourges of the Gezira, by hygienic methods, but difficulties in obtaining complete control raised the question as to whether control by breeding was possible, and in 1932-33 a start was made on the production of a blackarm resistant Egyptian cotton. Little result seemed likely by selection methods, but the application of Harland's back-crossing technique to crosses of Egyptian types with blackarm resistant American types obtained (through the courtesy of Mr. G. W. Nye) from Uganda seems likely to lead to the desired result.

---

* See articles by R. E. Massey *et al.* in this journal.

Let us now turn to the other part of the Plant Breeding Section's activities.

The areas for which *American* types are required are the irrigated pumping schemes on the banks of the Nile north of Khartoum, and rain-grown areas in the South. " The South " includes the Nuba Mountains area, the old Fung Province (now part of the Blue Nile Province), riverain areas in the Upper Nile Province and areas on the east and west of the Nile south of Juba in the Equatorial Province.

In these areas the type of cotton generally grown was " Pump Scheme Strain." The origin of this strain is a little obscure, but trials are reported in 1913 of Sunflower (which was imported in 1910), Nyassaland Upland (imported in 1912) and other American varieties; in 1914 a " Sudan type of Nyassaland Upland " was grown at Zeidab, and it was also reported that this type was grown extensively on the Berber estates. The probabilities are therefore that Nyassaland Upland, possibly mixed with Sunflower, was the origin of the Pump Scheme Strain. In 1925 the Pump Scheme Strain was well established and found to do well over the whole range; this adaptability may be largely owing to the mixture of plant types in the crop which is still its distinguishing characteristic.

In competition with Pump Scheme Strain, imported types have generally failed to show marked improvement. Similarly, straight selection in these strains has not yet produced a type which has proved itself markedly superior over a number of years. The Webber type imported from America might be considered an exception to this general rule, and this was grown on the Pump Schemes in the old Berber Province. A selection " Delrect I " from Webber also reached the stage of a " commercial " crop.

A type which was given the designation " XA1129 " had, in nearly all varietal tests in the north based on replicated plots, shown itself at least equal in lint yield to Pump Scheme Strain and much superior in lint quality. XA1129, however, has not come into favour, partly because of its origin—it was an off-type plant found in a plot of Meade, and Meade failed to create a good impression—and partly possibly because the plant itself does not show the hearty vegetative growth of the Pump Scheme Strain.* A trial was also given to this type in the Nuba Mountains, where it has done well in variety trials. It may come into favour there one of these days. It did not prove suitable for the extreme south.

Pink bollworm, however, has introduced another factor in the Berber schemes in the steadily increasing damage done by it to these longer-linted types, and about three years ago the cultivators there were prepared to abandon cotton growing altogether. Fortunately an introduction from the Punjab provided a partial solution. The cotton "513" is particularly early maturing and enables the cultivator to pick a reasonable crop before the pink bollworm destroys it. This cotton has not the lint quality of Webber, but selection work on lint improvement is in progress.

Considerable attention has naturally been paid to selection within the Pump Scheme Strain itself. For pumping schemes in Dongola, where the Pump Scheme Strain is most at home, the "514" selection and its substrains are being tested. The lint of this type is very well reported on and the yield should be superior to Pump Scheme Strain. Another strain, known as XA129, has been obtained which appears likely to be more suitable for the extreme south, where it is now being grown commercially. For this area, however, there was the probability that selections from Uganda types would do well, and Mr. Bailey made several selections from types growing there when he visited that country in 1929. Certain reselections from those types (*e.g.*, 511C) give good prospects.

Mention must be made of a long series of hybrid types sent by Dr. Harland from Trinidad. These have not been long enough under trial for any definite statement to be made, but during last season one reselection of (Cambodia × U4) × Cambodia parentage (grown under the number NT.15) showed great promise.

In a recent leading article *The Times* said: "No return will now be yielded but to organization and team work. . . . It is past all argument that to neglect or starve research is to invite national peril." In an agricultural country—especially in a country which depends to the extent the Sudan does at present on one crop, this is particularly true.

The ideal we have set for the Plant Breeding Section is that it should be organized, even to minute detail, on a sound scientific basis with a trained staff—senior and junior—working as a team.

---

* A large-scale trial is to be given to this type, however, in the 1937-38 season at Nuri.

In writing this article I have to acknowledge gratefully the loan of an unpublished manuscript on the subject from Mr. M. A. Bailey, as well as his advice and assistance.

Received March, 1937.

RECENT COTTON LEGISLATION IN THE BOMBAY PRESIDENCY

BY

W. J. JENKINS, M.A., B.Sc., I.A.S.
Officiating Director of Agriculture, Bombay Presidency.

One of the most recent and important developments of cotton cultivation in India has been the extension of superior, medium and long-stapled varieties in areas suitable for their successful cultivation. Such areas are to be found particularly in the Bombay Presidency and Sind, in Hyderabad and Baroda States and in certain districts of the Madras Presidency. The Local Governments and the Agricultural Departments concerned, aided by the expert advice and the financial assistance of the Indian Central Cotton Committee, have spared no pains to establish and extend the cultivation of stapled cotton to the best advantage of the cotton growers, and much thought and attention have been given to the planning and execution of measures designed to ensure an adequate premium for quality to the producers of improved and superior types of cotton. To achieve this end, legislative measures have been found to be necessary in many instances. The Indian cotton grower is generally illiterate, impoverished and unorganized. In many of the up-country cotton-growing tracts the system of primary marketing does not lend itself to the realization by the growers of full prices for their produce, especially if that produce is of higher quality than the average crop in surrounding areas. Malpractices, such as mixing of superior and inferior cottons, watering, etc., are common, and invariably result in ultimate loss to the cultivators. This article gives a brief account of the legislation which has been undertaken within the past fifteen years in the Bombay Presidency to protect the interests of the cotton growers and to maintain the reputation of superior types of cotton now in general cultivation. As might be expected, such legislative measures, in their early stages of introduction, often met with considerable opposition from different sections of the cotton-growing and trading communities. This opposition, however, was almost invariably withdrawn as the general intent of such measures became more clear and their potential value to the welfare and prosperity of the cotton growers of the Province became more fully understood and realized. The continued successful working of " cotton legislation " in the Bombay Presidency also depends upon the whole-hearted co-operation and consent of all sections of the cotton trade, of the cotton growers and of the official departments of Government concerned in the development of the main industry of the Province.

A.—COTTON TRANSPORT ACT, 1923.

In 1919, the Indian Cotton Committee was appointed by the Government of India to examine the work done in the establishment of long-stapled cottons in the various provinces, and to make recommendations for its extension in tracts considered suitable for that purpose. During the course of its enquiries, this Committee was particularly impressed by the extent to which mixing of superior with inferior types of cotton was being carried on in most cotton-growing tracts of India, and with the resulting bad name and loss of reputation which had been acquired by districts formerly celebrated for the quality of their cotton. The Committee's Report states that " even pure cotton from such districts is approached by buyers with distrust, and the prices offered for it are reduced accordingly." Evidence submitted to the Committee clearly showed that the import of short-stapled cottons into long-stapled cotton tracts for the sole purpose of mixing was being extensively practised and that the mixture, generally effected at the ginning or pressing factory, was passed off by unscrupulous dealers as the produce of the long-stapled area. In addition, where such mixtures of *kapas* (*i.e.*, unginned cotton) took place, cultivators were being supplied with mixed seed by middlemen and factories, still further accelerating the deterioration of their cotton crops. As a result of these investigations, the Committee recommended that the transport by rail of loose *kapas* or lint or of half pressed or full pressed bales—except when consigned to bona fide consumers or to ports for shipment outside India—should be prohibited except, in certain cases, under licence.

The India Central Cotton Committee, which was established in 1921 as the outcome of a recommendation of the Indian Cotton Committee of 1919, considered in very great detail the parent Committee's proposal for restriction on cotton transport in India. A special sub-committee was appointed to frame recommendations for submission to the Government of India. Finally, a resolution was passed to the effect that " an All India Enabling Act be passed empowering Local Governments to notify areas into which the import of cotton and/or *kapas* and/or waste and/or cotton seed shall be prohibited except under such rules as may be framed by the Local Government." A Cotton Transport Bill was introduced in the Legislative Assembly of the Government of India, giving effect to the recommendation of the Central Cotton Committee, and became law under the title of the Cotton Transport Act, 1923, in February of that year.

This Act gives powers to Local Governments, by notification in their local Official Gazettes, to prohibit the import of cotton and cotton-seed " by rail, road, river and sea " into certain scheduled areas, except under licence issued by the Director of Agriculture. The Government of Bombay took early steps to utilize the weapon thus provided for the protection of the long-stapled cotton tracts of the Bombay Presidency. In August, 1923, a Government Notification was issued defining, under the Act, six " protected " areas—viz., South Surat, Surat, and Olpad Ankleshwar areas in Gujerat, and Bagalkot, Bijapur and Kumpta Dharwar areas in the southern districts of the Presidency. A seventh " protected " area, the Nerbudda Mahi area in Broach district, was notified in May, 1931. Similar action has since been taken by Madras and the Central Provinces in British India and by the Indian States of Baroda, Rajpipla, Hyderabad and Indore for the safeguarding of their superior cotton crops.

A Cotton Transport (Amendment) Act was passed by the Indian Legislature in September, 1925, giving discretion to the Local Governments to prohibit the importation of cotton into a protected area by rail, road, river or sea *or by any one or more of these methods of transport.*

In the Bombay Presidency the provisions of the Cotton Transport Act have been most effective in checking unrestricted mixing of superior with inferior cottons in the Gujerat (Surat and Broach) areas and in the Southern Maratha (Kumpta and Dharwar American) tracts. In 1925, two years after the introduction of this legislation, evidence was placed before the Indian Central Cotton Committee regarding the marked improvement which had taken place in Kumpta cotton. At the same time, the Director of Agriculture, Bombay Presidency, reported that mixing in the Surat (Gujerat) area had been stopped " with great benefit to the growers of superior cotton." During the past decade, although several amendments to the Rules under the Act have been found necessary to facilitate its working under different local conditions, the main provisions of the Act have remained unaltered and there is no doubt as to their value and importance in protecting the interests of the growers of long-stapled cottons in numerous parts of the Presidency.

B.—COTTON GINNING AND PRESSING FACTORIES ACT, 1925.

The Indian Cotton Committee of 1919 recorded that the bulk of the malpractices—*e.g.*, mixing, watering, etc.—took place in the ginning and pressing factories. Accordingly certain important recommendations were made in the Committee's Report for the establishment of closer official control over factories with the object of checking such abuses. These recommendations form the basis of the Cotton Ginning and Pressing Factories Act of 1925.

The recommendations of the Indian Cotton Committee with regard to the control of ginning and pressing factories were carefully considered by the Indian Central Cotton Committee soon after that body came into existence in 1921. Draft legislation was prepared and, in September, 1923, the Committee passed a resolution recommending the Government of India to undertake legislation, on an All India basis, for the regulation of gins and presses, for compulsory marking of bales, maintenance of records of ownership and periodical statistical returns. An additional resolution advocated the inclusion in the All India Act of an enabling clause empowering Local Governments to introduce a system of licensing of ginning and pressing factories in their territories.

In September, 1924, a Cotton Ginning and Pressing Factories Bill was introduced in the Legislative Assembly at Delhi and circulated for opinion. The Bill did not include an enabling clause for licensing of factories, as proposed by the Central Cotton Committee, but the other provisions recommended by the Committee with reference to marking of bales, statistical returns, etc., were embodied. The Bill became law in March, 1925.

As finally passed by the Indian Legislature, the Cotton Ginning and Pressing Factories Act, 1925, and the Rules thereunder, provide for the marking of every bale pressed in a pressing factory in British India with a special mark allotted to the factory, and consisting of a letter, denoting the province in which the factory is situated, and a factory number. In addition, each fully pressed bale must bear a serial number in two parts indicating the cotton year in which it has been pressed and the running number of the bale according to the factory register. The Act also contains sections providing for the submission of weekly returns from all factories of the number of bales pressed, and for the maintenance of registers showing a daily record of pressings, the serial number of each bale and the person for whom it has been pressed. Certain structural requirements laid down, under Section 9 of the Act, for new ginning factories constructed after the commencement of the Act are designed to reduce to a minimum the risk of cotton being mixed or damaged while in progress through the ginning factory. The Act received general approval from the cotton trade.

In 1926, the East India Cotton Association, Bombay, passed a by-law making bales, not marked in accordance with the provisions of the Act, not tenderable against any hedge or futures delivery contract under the rules of the Association. It is very interesting to note that the great majority of Indian States in which cotton is grown have subsequently introduced similar legislation to the British India Act in their own territories. The Act has proved of very great value in improving the quality of long-stapled cotton in India and in enabling it to be marketed to the best advantage. From time to time experience has indicated the need for numerous modifications in the Act and Rules thereunder so as to avoid hardship to legitimate trade, but such modifications have not affected the fundamental purpose of the legislation or in any way reduced its efficiency.

In 1935, the Government of Bombay introduced supplementary legislation under the Cotton Ginning and Pressing Factories (Bombay Amendment) Act, 1936, to strengthen and extend the provisions of the original Cotton Ginning and Pressing Factories Act. The Amendment Act, which became law in March, 1936, gives power to the Local Government to introduce licensing of ginneries and pressing factories in areas where such action seems desirable in the interests of the cotton growers. It also prescribes penalties for the mixing of superior with inferior cotton, for watering and for the presence of excess seed or other foreign matter in ginned cotton in such licensed factories. The Amended Act extends to the Province of Sind* in the first instance, but the application of its provisions to certain portions of the Bombay Presidency is at present under consideration by the Government of Bombay.

---

* When the Cotton Ginning and Pressing Factories (Bombay Amendment) Act was passed in March, 1936, Sind was an administrative unit of the Bombay Presidency. Since April 1, 1936, it has been constituted as a separate Governor's Province.

C.—BOMBAY COTTON MARKETS ACT, 1926.

In 1897, the Berar Cotton and Grain Markets Law was passed by the Central Provinces and Berar Government, making provision for the establishment of organized and regulated markets in the Berar districts in which cultivators could dispose of their cotton and grain crops to the best advantage and thus secure a full competitive price for their produce. In 1919, the Indian Cotton Committee, as a result of its investigations into cotton marketing conditions in India, reported that "the cultivator is heavily handicapped in securing an adequate price for his produce by the number of hands through which it passes. He would be more likely to obtain this if the number of middlemen could be reduced and if he could be brought more directly in touch with the larger buyers." The Committee was impressed with the effectiveness of the Berar legislation in achieving this object and made a strong recommendation for the establishment of similar open and regulated cotton markets, on the Berar model, in other cotton-growing provinces, notably the Bombay and Madras Presidencies and the Punjab.

The Government of Bombay took early action on this proposal and in 1922 sought the advice of the Indian Central Cotton Committee with regard to the establishment of regulated markets in the main cotton-growing tracts of the Presidency. In 1923, a draft Bill was prepared on the general lines of the Berar legislation. In 1925-26, the Indian Central Cotton Committee conducted an extensive enquiry into the finance of the cotton crop up-country, the results of which indicated unmistakably that improved market facilities for the disposal of his cotton crop constituted the most urgent requirement of the cotton-grower in the main cotton-growing tracts of the country. The enquiry in the Bombay Presidency showed clearly the disadvantages and hardships from which the cultivator suffered in up-country markets by unfair deductions from the weight of his *kapas*, by incorrect weighments, by rate disputes and by his general dependence upon *arhatyas* or brokers in disposing of his cotton crop. With the support of this evidence, the Bombay Cotton Markets Bill became law in 1927 as the Bombay (District) Cotton Markets Act, 1926.

The Act is applicable to the whole of the Bombay Presidency except the city of Bombay. Provision is made whereby the Local Government may declare any place to be a cotton market established under the Act, after consulting the District Local Board or upon a representation from such local administrative body. In such places, declared by notification to be cotton markets under the Act, market committees must be appointed, not less than half the members of which must be elected by the neighbouring cotton growers. In the Rules, clauses are provided for the management and finance of the cotton market, the collection of market fees, the licensing of brokers, weighmen and market staff, the inspection of weights and measures and the fixation of trade allowances. No private market for the purchase or sale of cotton may be opened in or near places declared to be cotton markets under the Act.

The first open, regulated cotton market under the Bombay Cotton Markets Act (1926) was established in 1930 at Dhulia, an important cotton centre in West Khandesh. During the past five years, other markets have been constituted at Amalner, in East Khandesh, and at Baramati and Bailhongal in Poona and Belgaum districts respectively. The organization of similar centres is in progress at numerous other places in the main cotton-growing areas of the Presidency, despite a certain amount of opposition from middlemen, etc., but with the general support of the cotton growers.

D.—Bombay Cotton Control Act, 1935.

The Surat district of Gujerat in the northern portion of the Bombay Presidency has been renowned for many years for the quality and staple of its cotton, which is in great demand by spinners both in India and abroad. Much of the scientific work towards cotton improvement done by the Bombay Department of Agriculture has been concentrated in this area, and the introduction of the superior variety, commonly known as Navsari 1027 A.L.F., marks the high-water level of achievement in this direction. The long-stapled cottons of the Surat district were grown comparatively pure in 1912-13, but continued admixture with inferior short-stapled cotton increased until in 1919-20 100,000 bales of " Broach " cotton from Surat district were rejected in the Bombay market as not possessing those qualities which cotton from this tract was assumed by the trade to possess. The short-stapled variety used for mixing was known as " Goghari " and this was being extensively cultivated in the southern long-stapled areas of Surat district. With the introduction of Navsari 1027 A.L.F. by the Agricultural Department, and as a result of the interest and financial assistance of the Indian Central Cotton Committee in improving the cottons of Surat district, in 1923 the percentage of admixture fell as low as 4 per cent. However, this amelioration was not maintained. The cultivation of Goghari was encouraged by short-sighted traders, to whom the higher ginning percentage of the inferior cotton, in comparison with the superior varieties, resulted in immediate profits in their dealings with the cultivators. In 1934, the mixture of Goghari in the cotton crops of Surat district reached the alarming proportions of 55-60 per cent. It became obvious that most urgent and stringent measures were necessary if the reputation of the Surat cotton crop was to be saved and the interests of the growers adequately protected. These, in brief, are the conditions which resulted in the passing of the Bombay Cotton Control Act in 1935.

The application of the provisions of the Cotton Transport Act of 1923 to the notified areas of Surat and South Surat checked the importation of inferior cotton for mixing from outside these areas. However, this legislative measure could not deal with the increased cultivation of short-stapled Goghari cotton within the " protected " zones and its use for admixture with the long-stapled varieties also in cultivation there. Tests of the two cottons, carried out at the Technological Laboratory of the Indian Central Cotton Committee, Bombay, showed that the Goghari type was a coarse, short-stapled variety with an average staple length of 0·76 inch and not suitable for spinning more than 12's standard warp counts. On the other hand, the improved Navsari 1027 A.L.F. was undoubtedly among the best of Indian stapled cottons, with a staple length of 0·95 inch and suitable for 32's standard warp counts. It can therefore be readily recognized that the unrestricted admixture of two cottons of such varied staple properties and spinning value was having a most adverse effect on the reputation of the Surat crop.

In 1934, the Indian Central Cotton Committee sanctioned funds for the carrying out of a " Goghari survey " in the long-staple cotton tracts of Gujerat and the neighbouring areas of Baroda State. Intensive propaganda was undertaken to eliminate Goghari from the staple cotton areas and, finally, with the unanimous approval of the cotton trade, as indicated by resolutions passed at meetings of millowners' associations, gin-owners, commission agents, etc., and with the general approval of the cotton growers in the Surat area, legislation was introduced in the Bombay Legislative Council with the object of eradicating Goghari cotton from the Surat cotton-growing tract. A Bill, known as the Bombay Cotton Control Bill, framed on similar lines to the Madras Cotton Control

Act, 1932, which aimed at the elimination of "Pulachai" cotton (*Gossypium neglectum*) from the Tinnevelly tract of the Madras Presidency, was rapidly passed into law as the Bombay Cotton Control Act, 1935.

The Act provides for the total prohibition of the cultivation of Goghari cotton in notified areas of the Bombay Presidency and of its use in mixing with any other type of cotton. In addition, sections of the Act lay down penalties for the possession, use, or trade of Goghari cotton or of any cotton mixed with Goghari in such notified territories. Shortly after the passing of the Act, a Notification was issued by the Government of Bombay applying its provisions to the Surat district and to the Ankleshwar *taluka* of Broach and Panch Mahals district, in which the bulk of the Navsari stapled cotton crops are grown. Under Section 8 of the Act, certain senior officers of the Bombay Agricultural Department are empowered to enter land in the controlled areas and to uproot or cause to be uprooted Goghari cotton found under cultivation, and, in addition, to inspect ginning factories, godowns, etc., in such areas and to seize Goghari cotton, or cotton mixed with Goghari, which may be found in the hands of traders, etc. No prosecution under the Act can be sanctioned without the previous consent of the Director of Agriculture, Bombay Presidency.

It is still too early to give any definite indications as to the effectiveness of the Act, but there is evidence that Goghari cultivation is being given up in the Gujerat tract and in the neighbouring cotton-growing territories of Baroda State, in which similar legislation has been enacted. "Pockets" of short-stapled cultivation still persist in a few areas, but their total elimination, as a result of the application of the powers given under the Bombay Cotton Control Act, must take place within the very near future.

Received May, 1937.

COTTON SUPPLY BY FREE LABOUR

[The following article, from the *Leisure Hour* (1861), reads almost as if written quite recently, and is of some historical interest as indicating an early effort made to bring the Empire within the circle of important cotton producers.—Ed.]

There are upwards of half a million workers employed at the present moment in our cotton factories, and it has been estimated that at least four millions of persons in the kingdom derive their subsistence from the cotton trade. It appears from the last annual return of imports, that out of a grand total of 2,829,110 bales of cotton, India sent about 500,000, Egypt about 100,000, South America 124,000, and other countries 9,000, while the United States contributed very nearly 2,100,000 bales. Thus, all supplies at present from other parts of the world are petty driblets in comparison with the great American stream. Five-sevenths of the whole imports brought to our shores—in other words, five out of every seven pounds of raw cotton—are of Transatlantic production. The painful part of the affair lies in the fact that this produce, which enables our merchants to realize large profits, while our artisans receive good wages in the process of working it up, is entirely cultivated by some millions of slaves, who are compelled to work hard whether they like it or not, and we are by far America's largest customers for the production, making profitable use thereof. Practically, therefore, we are foreign partners in the great American slave cotton-growing concern; and we do not come into court with clean hands, protesting against the sin of slavery, till at least we have tried the experiment of a cotton supply by free labour, fairly and fully. In the opinion of thoughtful men, such a project is feasible; and the signs of the times imperatively call for its vigorous prosecution, for the present alarming rupture between the free and the slave States portends the partial or total arrest of the crop, in the event of war breaking out.

It is not easy to exaggerate the importance of this subject. So long as we are mainly dependent upon a single source of supply, always fluctuating, and which it is perfectly conceivable may be arrested altogether for a time, there is but a slight partition between us and the terrible calamity of widespread mercantile embarrassment, with an immense population out of employ, impoverished, starving, and, alas! largely criminal. It is neither wise nor prudent to remain in such a position, exposed to a jeopardy so fearful, when it may be remedied. Readers will well remember the potato failure of the year 1845, when, in one of the fine autumnal months, a mysterious disease seized the plant with fatal virulence, which, in a few days, destroyed the food of a whole people, and brought Ireland to the brink of ruin. In a similar manner many have long felt deep anxiety in view of a season of blight and blasting, to which all countries are liable, cutting off the cotton crop in the United States; or a rising of the slaves—also a very possible event, and one frequently threatened—which would have the same effect, and paralyze completely the most important branch of English manufactures and commerce. Even a diminished supply is such a severe calamity to employers and operatives as to excite general alarm. The short crop of 1849-50 raised the market price of raw cotton, to England alone, by the sum of at least £7,500,000, equivalent to 75 per cent. of rise on previous prices. Such enhancements necessarily strain the resources of manufacturers, limit production, cripple artisans, and damage general commerce.

The question of further sources of supply becomes additionally important when it is remembered that the demand for cotton manufactures—and consequently for the raw material—is constantly increasing, from the multiplication and advance of universal society. The great tide of production could not be rolled back, or kept at a standstill, without bringing on a social and political crisis. Our individual and national necessities compel us to keep it moving onward. Growing millions have to be provided with food and clothing, while there are obligations of vast amount to be liquidated, only by supporting and extending the mighty fabric of factory labour.

Happily, there is no necessity for despondency or alarm, as we need not be dependent on the United States, where the cotton plant is not indigenous. Mr. Bazley, an excellent authority on this subject, states that if a piece of ground the size of the county of York, in a suitable climate, and of a proper soil, were cultivated for cotton, it would supply more than is needed for our manufactures; and we have in our own possession much more suitable land than is required for this purpose.

These facts have led to the formation of an association for the purpose of looking into the whole question, and seeing how we may best avert the evils to which we are at present exposed. The

Cotton Supply Association, formed for the purpose of rendering our country independent of the United States, by promoting the culture and preparation of the product in other parts of the world, although of very recent date, has already done a large amount of work, and gives us the promise of complete success at no very distant period. It has held communication with every portion of the world where the soil and climate are capable of yielding cotton, and has furnished a large supply of valuable cotton seeds, with instruments for its cultivation, and for cleaning and preparing it for the market.

Sanguine expectations are entertained respecting the yield from India, both as to quantity and quality, if that country is duly attended to. It was, perhaps, the primal seat of the cotton plant in relation to the Old World. There it flourished in the time of Herodotus, 445 B.C., who noticed the trees bearing wool instead of fruit, of finer and better quality than the wool of sheep, of which the Indians made their clothes. Ever since cotton has been a staple product of the soil. It is estimated that there are at present not less than 24,000,000 of acres under cultivation, producing 2,400,000,000 pounds of cotton, of which the great proportion is consumed in the coarse manufactures of the country, for native use, only about one-tenth part being exported to feed our own. But hitherto the produce has not generally commanded attention in the English market—a sure sign that it has not been deserved.

From the peculiar action of modern cotton-spinning machinery, it is desirable to have the raw material of long staple, and in the cleanest possible condition—two points in which that of India has been far inferior to that of America.

But all the evils to which Indian cotton is heir, in its growth, culture, cleaning, packing, and transit, are of the preventable order, and may be made to disappear by bringing the ryot into contact with agents of English capitalists, thereby suppressing the class of middlemen, by circulating information on the best modes of cultivation, introducing improved implements, distributing suitable seeds, and bringing the interior of the country into convenient communication with the coast. On obtaining a good return for their produce by our becoming profitable customers, the native growers will certainly prove as much alive as farmers and planters elsewhere to their own interests, and evince it, both by raising cotton of the best possible quality, and sending it out in the best marketable condition. The great need of India for the due development of its resources is a good system of railways. But as this advantage cannot be expected at present, or perhaps till a distant day, owing to the enormous cost, a very important advance towards convenient intercommunication may be secured at a comparatively small expense by the proper treatment of the rivers. The Godavery, rising in the Western Ghauts, and flowing across the country some 800 miles to the Bay of Bengal, has been largely made available for the transport of goods by the engineering skill of Colonel, now Sir Arthur Cotton, at present in London, who, after having earned a retirement, has volunteered to go forth again to resume his labours. By the extension of such works, a prime desideratum for the cotton produce of India will be gained, cheap transmission to port, and protection from damage on the way. It is pleasant to write, not of needed reforms simply, but of their actual commencement. Towards the close of the past year, the Association received from the Secunder Begum of Bhopal a remittance for purchasing and sending out cleaning gins, in order to supersede the rude *churka* of the natives. More recently, some bales of cotton have reached London from the Punjub, where it was properly cleaned and pressed by the newest and best process, then floated ready packed down the Indus, and at once put on board the export vessel at Kurrachee, direct for Europe.

But India is only one of the countries to which we may look for our supplies of cotton produced by free labour. The most encouraging expectations are cherished in reference to Africa, both northern, eastern, and western. Besides the supply at present received from Egypt, the product of its own soil, that country might be made the outlet for abundant crops growing southward from thence to Western Abyssinia, which are now taken to sustain the rude native manufactures in the interior.

The latest discoveries of Dr. Livingstone in Eastern Africa show that the valley of the River Shiré and the neighbourhood of the great Lake Nyassa present a rich cotton-growing district, as is the case in the countries traversed in his great path from sea to sea. "This," the Doctor says, "is a great cotton-growing country. Every family appears to own a cotton patch." These natives will not only improve their material condition, by becoming cotton growers for our market, they will be relieved from the approach of the man-stealer, who is constantly prowling in their neighbourhood, and carrying them off to the coast. "There are thousands needing Christian instruction," says Dr. Livingstone, "and here are materials for lawful commerce, and a fine healthy country, with none of the noxious insects with which Captain Burton and Speke were tormented, and, with the single exception of thirty miles, water communication all the way to England." He adds: "Let but a market be opened for the purchase of their cotton, and they can raise almost any amount of it, and the slave trade will be abolished."

With regard to the West Coast of Africa, there is no question whatever that there is an ample field of supply, with a population perfectly willing to labour. It is an encouraging fact that the exports from this coast have risen from 1,800 bales in 1858-9 to nearly double that amount in twelve months. "Here," observes Lord Alfred Churchill, "you find a country in which the growth of cotton is indigenous, and where also labour is superabundant, and our object should be to turn that labour to good account, so that abundance of cotton may be grown." He further expresses his belief, which is well supported by facts, "that there is an amount of native talent in the negro—talent that requires but little development of civilization and Christianity to make it produce important results." The Yoruba country has the climate and soil adapted to the growth of crops of a superior quality, which will be for our use if only the people can pursue their labours in security. The great basin of the Niger appears to be England's natural arm of safety for cotton, a region only about the distance of the United States from our shores, where there are millions of population ranging over an area of 800,000 square miles, constantly engaged in the growth of cotton for their own use, and who can sell or barter it to us so that it will be sold in Liverpool far below the cheapest rate of American cotton.

Reference might be made to Australia, where the governor of Queensland has offered premiums of considerable amount to all settlers in the colony who shall grow cotton; and experiment has proved the suitableness of the soil and climate for the cultivation. In the West Indies, under the auspices of the Haytian Government, the immigration of free black and coloured field labourers is in process, for the express purpose of extending cotton culture, and we have in London a Jamaica Cotton Company founded for its revival in that beautiful island. Recently, cotton has begun to arrive in Liverpool from several new sources, and visitors to the Crystal Palace may be interested to know that Sir Joseph Paxton has authorized the raising of some specimens of the cotton plant in the department of tropical productions, and that a collection of samples of cotton from all parts of the world will shortly be prepared for exhibition.

Our dependence upon the United States, through the absence of competition, has cost us dear. During the years 1843-5, the average price of raw cotton was 4⅝d. per pound. It has never been so low since; and the calculation is in detail before us, that through the fifteen years from 1846 to 1860 inclusive, we have paid a grand total of very nearly £82,000,000 sterling, as the simple cost of the *excess* over the average stated, while the price from free labour countries need not equal that average. Thus this £82,000,000, for any real advantage we have derived from it, might as well have been tossed into the Atlantic; while, had it been thus applied, it would have intersected India with good roads, cheap railways, and convenient water communication.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

World's Crops.—Every time we come to revise this table the total of Outside Growths is increasing. When it was last given in the January issue the estimated total for the current season was 18,531,000 bales. When it was revised for the special article in the April issue the total had increased to 19,573,000 bales. This time it is 19,875,000 !

The principal change since April is the further increase of the Indian crop from 5,959,000 bales to 6,307,000 in the Government's Supplementary forecast, set off to some extent by the reduction of the Argentine crop from 360,000 bales to 240,000 by drought.

The world's total of All Kinds is now 32,274,000 bales (excluding linters), which, of course, is a new record by a long way. The pre-war record of 27,355,000 bales in 1914 was not exceeded till 1925 (28,689,000) and again in 1926 (28,995,000) which has held the record till now.

In the " World's Cotton Crops "* the writer stated that in 1914 " many in the industry had become convinced that the world required a steady and *cumulative* increase of the world's crops, which was put as high as a million bales per annum." It is a tragic commentary on post-war developments that in 1934, after twenty years, the world's total was still less than in 1914, and it is only now beginning to show any sign of a real increase on pre-war figures.

American Crop.—The March figures are added to the lower half of the table and the final figures published in May appear in the upper half. It will be seen that neither made much difference in the semi-final figures of December, while the final crop figure of 12,399,000 bales (of 500 lbs.) is extraordinarily close to the first estimate of 12,481,000 on August 8.

Indian Crop.—The detailed figures (from the supplementary forecast in April) of the distribution of the Indian crop by varieties between long and short staple are of course only provisional, because later on the Indian Central Cotton Committee publishes a more detailed statement in which they allocate parts of the Broach and other crops to short staple and some of the C. P. Oomras crop to long staple. The nett effect of this last year was to transfer about 300,000 bales from long staple to short and presumably there will be a similar transfer this year. Meantime, however, it will be seen from this table, which is based throughout on the gross figures according to provinces or areas, that the April figures this year show a further slight improvement in the proportion of long staple on last year's figures, which, by the way, have been very severely revised.

---

* Note to the Second Impression (1923).

Egyptian Crop.—The June estimate, which is usually very close to the final ginning figures, should be received in time to be included in this table, but judging from the ginning returns up to the end of March it should show very little change from the December estimate of 9,446,000 kantars formerly used.* It is, of course, a new record for the crop but not for the acreage (which was 2,082,000 feddans in 1930), so that the record average yield of 5·31 kantars per feddan is all the more striking. As a matter of fact there are higher figures of average yield in the earliest statistical records of the crop—*e.g.*, 5·80 kantars per feddan in 1897—but these are of rather doubtful authenticity. The average yield of 3·78 kantars per feddan in 1931 given in the table is not the lowest on record (in 1916 it was only 3·06), but the steady recovery since then is very satisfactory. It is, of course, partly due to the substitution of heavier yielding varieties like Giza 7 for Sakel, but that must not be allowed to obscure the fact that the average yield of practically every variety, even Sakel, has been very high in recent years. Details of this year's crop by varieties, however, will not be available until June and will appear in our October issue.

The Egyptian Carryover figures given in the next table are rather striking for they show an increase at mid-season of 520,000 kantars over January, 1936. That is, of course, not surprising in view of the big crop, though the consumption also is rising, but it is also not unwelcome, for the steady reduction of the Carryover from 6,959,000 kantars in July, 1931, to 3,408,000 kantars in July, 1936, had brought the Carryover down to almost sub-normal figures.

Consumption.—The U.S. Consumption figures continued the recent very marked rise until March set up a new record for all time with a total of 799,302 bales of All Kinds against the previous highest of 697,261 in June, 1933. That, however, was a flash in the pan which lasted only three months, and was due to the fact that America had just gone off the gold standard. This time the monthly figure has been over 600,000 bales for eight consecutive months, for April

---

*** The actual figure of 9,107,200 kantars fell considerably short of this expectation.**

showed only a moderate reduction partly due to the smaller number of working days.

The Federation figures of World's Consumption were rather more complete than recently because the German figures reappeared, though still without the missing figures for the four previous half-years, but Russia and Spain are still only estimates and there are again no figures at all for Italy, so that we are reduced to repeating the U.S. estimate of last year. The result is, however, to confirm fairly well Garside's figures (as revised) as follows:

WORLD'S CONSUMPTION.

GARSIDE AND FEDERATION.

	American.			*Outside Growths.*	*All Kinds.*
	U.S.A.	*Other Countries.*	*Total.*		
First half, 1936-37.					
Garside	3,767	2,643	6,410	8,471	14,881
Federation	3,767	2,755	6,522	8,129	14,651
Garside					
February	651	440	1,091	1,428	2,519
March	762	458	1,220	1,505	2,725
April	703	463	1,166	1,504	2,670
9 months' Total	5,883	4,004	9,887	12,908	22,795

Since then Garside's estimates for February to April have been published and they bring the totals up to such figures that it is quite clear that the season's totals will be well over 13 million bales of American and 17 million bales of Outside Growths.

In comparing this total of fully 30 million bales of all kinds with the World's Crops figure of 32,274,000 bales it must be remembered that the consumption figures are for mill consumption only and that the world's domestic consumption for handloom weaving, etc., may amount to as much as 2 million bales, so that the balance of Consumption and Production this season is extraordinarily even.

Prices.—The movements of prices since our last issue have been positively hectic. The announcement in February that our Government's expenditure on armaments over the next five years would amount to £1,500 millions started a world movement towards higher prices for all primary commodities which carried cotton in its wake to the highest levels since June, 1930, and the March contract in New York went out at 14·85 cents, while July futures in Liverpool touched 7·99d. This was quickly followed, however, in April by a combination of scares beginning with the rumour that America, owing to the huge imports of gold from Russia, intended to reduce the price of gold, which would, of course, have meant deflation of prices of all commodities. Following this came Chamberlain's new Growth of Profits Tax in the Budget which had a very bad " market," while as far as cotton itself was concerned better crop news and prospects of a larger increase of acreage tended to lower prices. The result was a sharp fall in all markets in the latter part of March which continued throughout April and most of May with a further sharp fall in the second week of June.

Egyptian futures prices have been even more erratic largely as the result of manipulation by the Liverpool operators who seem to have turned their attention from Sakel to Giza 7 and then for a time to Uppers, but the detailed movement of the relative prices of these varieties to American and to each other and of near and distant months would require a whole page of tables to itself.

Spot prices of other varieties as given in our last table show very irregular movements relatively to American. Most of them have gained ground as American fell, especially Sakel and Uppers; but Tanguiss, which was relatively high in January and February, has reacted sharply, and is again below Uppers.

Revised to 12*th June*, 1937.

WORLD'S COTTON CROPS.

(Bales of 500 Lbs.—000's.)

	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.
U.S.A. Lint	17,096	13,002	13,047	9,637	10,638	12,399
Linters	1,067	912	982	1,001	1,089	1,300
Total	18,163	13,914	14,029	10,638	11,727	13,699
Mexico	203	99	255	223	251	373
Brazil	575	438	1,014	1,359	1,765	1,800
Peru	228	237	278	342	374	372
Argentine	165	146	191	295	367	240
Other South American	46	39	74	69	94	143
India*	4,007	4,656	5,108	4,857	5,933	6,307
China	1,733	2,195	2,652	3,033	2,410	3,760
Japan, Korea, etc. ...	99	133	197	223	230	232
East Indies, etc. ...	15	13	15	15	14	16
Russia	1,846	1,776	1,844	1,772	2,347	3,300
Persia	107	79	137	200	120	161
Iraq, Ceylon, etc. ...	1	†	†	2	4	8
Asia Minor and Europe	131	68	202	263	377	431
Egypt	1,271	991	1,715	1,511	1,707	1,821
Sudan	188	110	126	237	199	259
East Africa (British)	182	269	274	273	331	338
South Africa (British)	3	2	3	3	2	3
West Africa (British)...	5	20	23	47	48	40
Non-British Africa ...	96	121	154	165	223	224
West Indies (British)...	2	2	3	4	4	5
West Indies (Others) ...	31	26	24	31	26	27
Australia, etc.	4	11	18	14	14	15
World's Total ...	29,101	25,345	28,337	25,576	28,567	33,574
Outside Growths ...	10,938	11,431	14.308	14,938	16,840	19,875
Per cent. on Total ...	37·6	45·1	50·5	58·4	58·9	59 2

* Government estimate, 400 lb. bales. † Less than 500 bales.

AMERICAN CROP (EXCLUDING LINTERS).

	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.
Acreage planted (000's)	39,110	36,494	40,248	27,860	27,888	30,960
Acreage harvested ...	38,704	35,891	29,383*	26,866	27,335	30,028
Crop (running bales)...	16,629	12,710	12,664	9,472	10,420	12,142
Yield per acre (lbs.) ...	211·5	173·5	212·7	171·6	186·3	197·9
Season's average spot price (Liverpool—pence per lb.) ...	4·82	5·62	6·02	6·93	6·52	—

PROGRESS OF THE SEASON 1936–37.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	30,621	30,621	30,621	30,621	30,932	30,932
Acreage harvested ...	29,924	29,720	29,720	29,720	30,054	30,054
Crop (500 lb. bales) ...	12,481	11,121	11,609	12,400	12,407	12,387
Yield per acre (lbs.)...	199·7	179·2	186·9	199·7	197·6	197·0

* Less 10,396,000 acres special abandonment.

INDIAN—AREA AND CROP *BY VARIETIES.*

Varieties.	1934-35.			1935-36.			1936-37.		
	Area.	*Crop.*	*Yield per Acre.*	*Area.*	*Crop.*	*Yield per Acre.*	*Area.*	*Crop.*	*Yield per Acre.*
Mainly under ⅞" Staple:									
Oomras, Khandesh	1,152	239	83	1,285	293	91	1,299	265	82
Central India ...	1,806	189	42	1,803	304	67	2,121	308	58
Barsi and Nagar	2,074	306	59	2,451	312	71	1,920	337	70
Berar	2,915	443	61	2,848	349	49	2,716	586	86
Central Prov. ...	1,286	174	54	1,220	267	88	1,253	224	72
Total ...	9,233	1,351	59	9,607	1,645	68	9,309	1,720	74
Dholleras	2,965	599	81	2,733	634	93	2,732	533	78
Bengal Sind* ...	3,847	1,328	138	3,639	1,337	147	3,830	1,520	159
Comillas, Burmas, etc.	592	131	89	637	144	90	629	152	97
Coconadas ...	184	30	65	170	25	59	161	27	67
Salems	181	33	73	164	30	73	187	37	79
Total under ⅞" ...	17,002	3,472	82	16,950	3,815	90	16,848	3,989	95
Per Cent. of Grand Total	70 8	71·5	—	65 2	64·3	—	66·8	63·2	
Mainly ⅞" and above:									
American, Punjab	841	398	189	1,529	737	193	1,614	894	222
,, Sind ...	211	86	163	385	155	161	561	297	212
Broach	1,384	148	43	1,367	329	96	1,436	312	87
Coompta-Dharwars	1,167	146	50	1,479	173	47	1,128	148	52
Westerns & Northerns	1,454	139	38	2,163	283	52	1,632	169	41
Tinnevellies ...	554	132	95	623	137	88	625	155	99
Cambodias ...	546	208	152	525	192	146	534	202	151
Hyderabad-Gaorani	864	129	60	978	112	46	841	141	67
Total ⅞" and above...	7,021	1,386	79	9,049	2,118	94	8,371	2,318	111
Per Cent. of Grand Total	29·2	28·5	—	34 8	35·7	—	33·2	36·8	—
Grand Total ...	24,023	4,858	81	25,999	5,933	91	25,219	6,307	100

* United Provinces, Rajputana, Sind, Punjab, etc.

EGYPTIAN CROP.

	1931-32.	1932-33.	1933-34.	1934-35.	1935-36.	1936-37.
Area (feddans, 000's) ..	1,683	1,094	1,804	1,732	1,669	1,716
Crop (kantars, 000's):						
Alexandria adjusted arrivals	6,563	5,050	8,438	7,540	8,375	9,210
Government figures*	6,357	4,956	8,575	7,556	8,535	9.107
Average yield (kantars per feddan)*	3·78	4·53	4·75	4·36	5·11	5·31
Season's Average Spot Prices (Liverpool—Pence per lb.).						
Sakel	6·80	7·79	8·05	8·52	9·22	..
Percentage on American	41·1	38·6	33·7	22·9	41·4	-
Uppers	5·68	7·01	6·64	7·57	7·48	-
Percentage on American	17·8	24·7	10·3	9·2	14·7	-

---

* Final revised figures, including Scarto.

WORLD'S CARRYOVER OF *EGYPTIAN* COTTON.

(KANTARS 000'S.)

End of	*Stock and Afloat.*		*U.S.A.*		*Alexandria.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*
	U.K.	*Continent.*	*Mills.*	*Warehouses.*				
1931, January	*630*	*293*	*341*	*129*	*5,349*	*6,742*	*1,185*	*7,927*
July ..	600	165	212	108	4,452	5,541	1,418	6,959
1932, January	*1,013*	*248*	*145*	*63*	*5,521*	*6,990*	*1,447*	*8,437*
July ..	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	*878*	*218*	*134*	*171*	*4,255*	*5,656*	*1,425*	*7,081*
July	742	202	131	143	2,228	3,446	1,635	5,081
1934, January	*1,507*	*337*	*142*	*106*	*3,157*	*5,249*	*1,687*	*6,936*
July ..	1,132	248	174	135	1,491	3,180	1,868	5,048
1935, January	*968*	*435*	*132*	*100*	*2,230*	*3,865*	*2,242*	*6,107*
July ..	533	285	130	110	546	1,604	1,965	3,569
1936, January	*690*	*383*	*98*	*87*	*2,368*	*3,626*	*2,078*	*5,704*
February	750	233	107	92	2,241	3,423	—	—
March ..	728	345	112	97	2,149	3,431	—	—
April	630	308	111	103	1,913	3,065	—	—
May ..	600	293	117	100	1,567	2,677	—	—
June ..	518	307	137	85	988	2,035	—	—
July ..	420	233	128	81	619	1,481	1,927	3,408
August	375	158	129	86	489	1,237	—	—
September	338	135	123	76	1,307	1,979	—	—
October	473	247	118	65	2,198	3,101	—	—
November	653	262	111	60	2,691	3,777	—	—
December	795	217	112	54	2,827	4,005	—	—
1937, January	*773*	*270*	*117*	*54*	*2,977*	*4,191*	*2,033*	*6,224*
February	780	315	121	73	2,784	4,073	—	—
March ..	758	255	143	65	2,112	3,333	—	—
April ..	653	240	148	75	1,686	2,802	—	—
May ..								

WORLD'S CONSUMPTION OF COTTON.

(From the Statistics of the International Federation.)

(*Running Bales, 000's—Excluding Linters.*)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*Others.*	*Totals.*
American.	1931-32	1,342	3,343	4,744	2,636	251	12,316
	1932-33	1,400	3,836	6,004	2,655	276	14,171
	1933-34	1,461	3,976	5,553	2,238	306	13,534
	1934-35	1,049	2,782	5,241	1,997	285	11,354
	1935-36	1,378	3,033	6,220	1,793	311	12,735
1st *Half*—	1936-37	*621*	*1,304*	*3,767*	*665*	*165*	*6,522*
Indian.	1931-32	183	727	21	3,834	23	4,788
	1932-33	126	600	16	3,455	23	4,220
	1933-34	234	844	14	3,638	42	4,772
	1934-35	342	889	22	4,501	18	5,772
	1935-36	386	782	55	4,352	23	5,598
1st *Half*—	1936-37	*202*	*409*	*39*	*2,251*	*7*	*2,908*
Egyptian.	1931-32	301	480	53	120	26	980
	1932-33	301	442	58	104	29	934
	1933-34	366	515	69	119	39	1,108
	1934-35	362	552	55	185	41	1,195
	1935-36	356	558	45	164	60	1,183
1st *Half*—	1936-37	*184*	*264*	*24*	*88*	*43*	*603*
Sundries.	1931-32	560	1,730	26	1,133	786	4,235
	1932-33	421	1,797	32	1,922	856	5,028
	1933-34	409	2,137	33	2,154	964	5,697
	1934-35	754	3,099	19	2,456	1,152	7,480
	1935-36	613	3,264	19	2,694	1,288	7,878
1st *Half*—	1936-37	*389*	*1,867*	*14*	*1,644*	*704*	*4,618*
All kinds.	1931-32	2,386	6,280	4,844	7,723	1,086	22,319
	1932-33	2,248	6,675	6,110	8,136	1,184	24,353
	1933-34	2,470	7,472	5,669	8,149	1,351	25,111
	1934-35	2,507	7,322	5,337	9,139	1,496	25,801
	1935-36	2,733	7,637	6,339	9,003	1,682	27,394
1st *Half*—	1936-37	*1,396*	*3,844*	*3,844*	*4,648*	*919*	*14,651*

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

1935-36.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
November ...	507·8	24·8	496·1	1·8	5·2	4·8	59·5
December ...	498·3	26·2	487·3	1·8	5·5	3·7	55·2
January ...	591·3	26·0	578·1	2·2	6·6	4·4	56·0
February ...	516·6	25·8	504·2	1·9	5·6	5·0	53·6
March ...	548·9	25·0	536·9	1·8	5·0	5·3	60·8
April ...	576·8	26·5	562·7	1·7	5·8	6·6	61·4
May ...	530·8	25·3	518·3	1·4	5·2	5·9	64·7
June ...	556·3	25·3	542·8	1·4	5·3	6·9	64·0
July ...	603·2	26·2	588·3	1·8	6·1	7·0	70·2
1936-37.							
August ...	574·3	27·3	560·3	1·7	5·6	6·7	65·4
September ...	629·7	29·0	613·7	1·7	5·9	8·5	67·9
October ...	646·5	29·7	630·9	1·8	6·0	7·8	72·5
November ...	626·7	30·6	612·0	1·9	5·5	7·3	63·8
December ...	692·9	33·0	676·8	2·0	6·3	7·7	61·9
January ...	678·1	32·7	662·5	1·8	6·5	7·2	63·4
February ...	664·4	33·6	649·0	1·8	6·2	11·5	63·6
March ...	779·3	33·9	759·8	2·2	7·6	9·7	74·3
April ...	718·9	32·7	700·7	1·9	7·8	8·6	72·8

HIGHEST AND LOWEST FUTURES PRICES.

1935-36.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
November	11·97	10·86	6·54	6·07	9·51	8·44	7 77	6·82
December	11·77	11·01	6·49	6·14	9·20	8·57	7·71	7·28
January ...	11·58	10·90	6·24	5·77	9·22	8·54	7·53	7 03
February	10·99	10·63	5·87	5·62	8·81	8·29	7·14	6·84
March ...	11·34	10.59	6·08	5·66	8·76	8·34	7·20	6·90
April ...	11·31	10·80	6·11	5·83	8·72	8·45	7·18	6·94
May ...	11·58	11·02	6·13	5·93	8·68	8·48	7·30	6·95
June ...	11·79	10·60	6·34	5·79	9·20	8·44	7·45	6·84
July ...	*12·78*	11·51	*6·84*	6·23	*11·04*	9·14	*7·92*	7·35
1936-37.								
August ...	12·16	*11·30*	6·53	*6·10*	10·79	9·96	7·49	6·99
September	12·30	11·50	6·68	6·13	10·18	*9·67*	7 32	*6·91*
October ...	12·21	11·51	6·78	6·51	10·80	9·93	7·45	7·14
November	11·92	11·51	6·75	6·46	10·91	9·93	7·56	7·17
December	12·54	11·85	6·89	6·54	10·24	9·80	7·77	7·31
January ...	12·85	12·24	7·15	6·73	10·15	9·83	8·05	7·61
February	12·77	12·36	7·16	6·89	10·15	9·49	8·40	7·83
March ...	*14·70*	12·79	*7·96*	7·18	*12·50*	9·89	*9·73*	8·39
April ...	14·53	12·76	7·94	7·00	12·48	10·60	9·72	8·75
May ...	13·19	12·58	7·33	6·94	11·15	10·36	9·40	8·83

Maximum and minimum each season in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1935-36.	*American (Middling). Pence per lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil.*		*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
				Pernam (Fair).	*San Paulo (Fair).*				
November	6·59	87·3	101·8	99·5	101 8	111·7	119·3	120·2	153·9
December	6·41	87·8	101·6	100·0	102·3	114·8	119·5	120·1	148·8
January...	6·14	82·9	101·6	100·0	102·4	113·8	121·2	119·1	157·8
February	6·04	82·3	100·8	99·2	101·7	111·6	121·5	116·9	149·5
March ...	6·44	78·6	100 0	96 9	100·8	110·1	119·4	114·4	142·9
April ...	6·62	76·6	100·0	97·0	100·8	109·8	118·9	112·5	138·2
May ...	6·64	72·6	99·2	94·7	99·2	106·0	118·1	113·6	130·6
June ...	7·18	73·8	98·6	93·0	95·8	104·2	115·3	112·3	128·8
July ...	7·10	79·6	97·9	92·3	94·4	103·5	115·5	126·1	158·2
Season's average	6·52	79·9	100·2	96·8	99·7	108·9	116·6	114·7	141·4
1936-37.									
August ...	6·70	74·0	97·0	91·8	94·0	104·5	117·9	117·3	153·4
September	6·73	76·1	99·3	94·1	96·3	106·7	117·8	109·5	150·8
October ...	6·81	74·0	100·3	95·2	97·4	106·9	123·0	106·5	167·6
November	6·72	75·0	98·8	95·1	97·3	107·7	124·1	109·8	170·4
December	7·10	75·4	98·6	94·4	96·5	107·0	125·4	110·3	146·5
January ...	7·34	73·3	98·6	94·6	96·6	106·8	130·7	111·9	139·6
February	7·41	71·0	97·6	92·8	96·2	106·3	130·0	114·3	137·8
March ...	7·95	73·2	98·7	94·3	97·5	106·9	125·8	122·1	159·5
April ...	7·22	74·2	98·6	93·8	97·2	107·6	128·4	128·1	155·1
May ...	7·36	74·3	98·6	93·9	97·3	107·5	127·9	133·0	157·1

EMPIRE COTTON CROPS FOR THE YEARS 1926–36, EXCLUDING INDIA.

(In bales of 400 lbs.)

The seasons are given as covering two years (*e.g.*, 1926–1927) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Tanganyika, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the *latter* of the two years at the head of the column.

COUNTRY.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	
(1) Anglo-Egyptian Sudan ..	121,131	148,118	126,115	161,536	157.769	120.310	234.964	137,384	157,625	296,131	248,285	(1)
(2) Uganda ..	180,859	131,728	138,486	204,057	129,969	191.305	203,265	294,828	285.986	253,242	321,348	(2)
(3) Kenya ..	2,046	1,232	1,241	1,984	1.518	737	1,735	4,277	6,750	8,774	15,636	(3)
(4) Tanganyika ..	24,280	15,966	32,954	27,785	23,135	11.351	18,039	30,834	39.009	58,548	63,426	(4)
(5) Nyasaland ..	4,976	2,792	4,470	6.095	9,331	4.205	5,067	5,942	10,713	21,006	13,730	(5)
(6) N. Rhodesia ..	506	32	17	—	—	—	—	—	—	—	—	(6)
(7) S. Rhodesia ..	6,803	639	90	280	1.481	1.974	579	355	689	566	329	(7)
(8) Union of South Africa and Swaziland	20,381	10,242	11,013	9,774	16,213	8.123	2,801	1,860	2,440	2.966	1,983	(8)
(9) Nigeria ..	47,909	27,464	20,930	32,126	43.925	18.850	6,350	24,366	28,247	58.726	60,193	(9)
(10) Gold Coast ..	1,218	285	264	296	200	297	263	68	144	146	128	(10)
(11) Cyprus ..	4,614	2,110	2,146	3,520	4,718	2.865	1,119	913	1,865	5,214	2,993	(11)
(12) Malta ..	507	342	541	379	293	201	41	34	32	20	32	(12)
(13) Iraq ..	3,500	1,800	5,200	4.700	3.300	960	409	*	—	—	—	(13)
(14) Ceylon ..	261	186	202	380	248	95	47	34	92	124	293	(14)
(15) Queensland ..	7,179	5,880	10,266	6.296	13,999	12.228	4,975	13.903	21,924	17,653	16,631	(15)
(16) Fiji	824	356	114	271	308	266	90	8	39	29	64	(16)
(17) West Indies ..	5,941	6,076	4,088	5,377	5,672	5,106	2,524	2,614	3,618	4,720	4,565	(17)
	432,935	355,248	358,137	464,856	412,169	378,873	482,268	517,420	559,173	727,865	749,636	
		Percentage Decrease 17·9	*Percentage Increase* 0·8	*Percentage Increase* 29·7	*Percentage Decrease* 11·3	*Percentage Decrease* 8·0	*Percentage Increase* 27·3	*Percentage Increase* 7·3	*Percentage Increase* 8·0	*Percentage Increase* 30·2	*Percentage Increase* 3·0	

* *No longer included in Empire figures.*

AN INEXPENSIVE METHOD OF SELFING COTTON FLOWERS

THE following letter has recently been received by the Editor:

PLANT BREEDING SECTION,
AGRICULTURAL RESEARCH SERVICE,
SUDAN.
March 18, 1937.

DEAR SIR,

When Mr. Ayyar's article appeared in this Journal (Vol. XIII., No. 1, 1936), the possibilities of gumming as a means of selfing cotton flowers were being investigated at Shambat.

Two years' use of gum for selfing has demonstrated its quickness and cheapness; the method, however, is advocated for use only under irrigation conditions as rain would wash off the adhesive. The following is a brief description of the system now employed in the Northern Sudan :

350 gms. of gum arabic are dissolved in 580 c.c. of water and a " wetter " is added to facilitate application. The addition of 0·5 gm. Agral II. has been found efficacious, but doubtless any of the proprietary chemical " wetters "would be effective.

The best way of applying the gum is by means of a stick with a piece of rubber tube attached. This can conveniently be made of a penholder with a piece of 5 mm. (internal diameter) rubber tube projecting about 7 mm. beyond its end. The end of the rubber is dipped in gum and pressed once over the tip of the bud. The gum dries and prevents the petals from opening. Selfing is normally done in the late morning or the afternoon of the day preceding flowering, and the gummed flowers are checked and tagged on the following morning.

It is hoped that plant-breeders in other arid regions may find this method of use.

Yours faithfully,
R. L. KNIGHT.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

369. CONFERENCE OF RESEARCH WORKERS ON COTTON, BOMBAY. Under the auspices of the Indian Central Cotton Committee, the first conference of research workers on cotton was held in Bombay from March 4-6, 1937. Sir Bryce Burt presided on the first day, and Dr. W. Burns on the second and third days. Many cotton research workers from all parts of India attended. A number of papers on technology, mycology, plant breeding, agronomy, and entomology were read, and were followed by interesting discussions. The Conference was the means of bringing into close contact workers engaged in cotton problems in different parts of India, and of helping them to exchange views on matters of common interest.

370. INDIAN CENTRAL COTTON COMMITTEE. (*Ann. Rpt. to August* 31, 1936, recently received.) A detailed account of the work of the year in connection with the following: the development of cotton production and the extension of superior types into general cultivation; legislation for the better growing and marketing of cotton; agricultural and technological research; publicity and propaganda work; statistical information useful to trade. The adoption of dry-farming methods was suggested in tracts of uncertain rainfall with a view to the extension of the area suitable to longer stapled cottons. Steps were taken for the improvement of Dholleras cotton and for the establishment of the 300,000 acre block of long-staple cotton in Sind. Much success attended the efforts of the Lancashire Indian Cotton Committee, and over 500,000 bales of Indian cotton were exported to the United Kingdom. The Cotton Transport Act and the Cotton Ginning and Pressing Factories Act, and other legislation passed for the better growing and marketing of cotton, functioned satisfactorily in most districts.

In connection with research, funds were provided for 46 research and other schemes, 6 research students were under training, 4 in India and 2 abroad.

Further progress was made in the work of the Technological Laboratory, a total of 127 samples being tested for the industry compared with 39 samples in the previous year.

At the Institute of Plant Industry, Indore, the programme of work covered the general botany, physiology and genetics of cotton, in addition to several agricultural investigations dealing with cotton and other crops. The Malvi 9 strain met with much success, and measures were taken to multiply it up for distribution. Tests on this cotton showed its spinning value to be some 50 per cent. better than the local mixture grown on the same land at Indore. Work in connection with the Malvi strains is being continued. The Institute is becoming increasingly helpful to the states of Central India and Rajputana, on whose behalf it investigates specific crop problems and disseminates knowledge of more efficient agricultural practices.

371. INDIAN CENTRAL COTTON COMMITTEE. At the thirty-fourth meeting, held on March 2 and 3, the following important matters were discussed: The future policy to be followed in connection with the renewal of research and seed distribution schemes; the Bombay and Central Provinces Rules under the amended Cotton Ginning and Pressing Factories Act; the reports of the

Technological Research Sub-Committee and of the Technological Laboratory; the proposal for the broadening of the Broach Hedge Contract; the progress made with the establishment of regulated cotton markets in Bombay, Madras and the Central Provinces; the proceedings of the Provincial Cotton Committees for Sind and the Punjab; the improvement of the official cotton forecasts.

372. AGRICULTURE AND ANIMAL HUSBANDRY IN INDIA, 1933-34 AND 1934-35. Pt. I. We have recently received a copy of this publication, which was formerly known as the *Review of Agricultural Operations in India.* It is proposed to issue the new report annually in two parts, Pt. I. dealing with Crop Production, and Pt. II. with Animal Husbandry.

The report contains statistics of cotton acreage, production, and exports for the 1933-34 and 1934-35 seasons. The progress made by the Indian Central Cotton Committee in its work of improvement and development of the growing, marketing, and manufacture of cotton, is described, and the various research schemes of the Committee are discussed. An account is also included of the work of the Indore Institute of Plant Industry during the period under review.

373. INDIAN COTTON INDUSTRY: DISTRIBUTION OF LOOMS AND SPINDLES. (*Ind. Text. J.*, **57**, 1936, p. 32. From *Summ. of Curr. Lit.*, xvii., **3**, 1937, p. 84). A list is presented which shows the principal cities and towns in India where cotton mills are situated, with the number of spindles and looms in operation. The modern mill industry comprises 366 mills with nearly 10,000,000 spindles and 120,000 looms, and is distributed over about 100 cities and towns. The list shows the growing strength of the industry in the Western Indian states, Bengal, and the Coimbatore area in South India.

374. INDIAN COTTON: STATISTICS. We have received from the Indian Central Cotton Committee copies of Leaflets Nos. 2, 3 and 4 (1935-36) giving statistics of the following: stocks of Indian raw cotton held in India by the mills and the trade on August 31, 1936; receipts at mills in India of raw cotton classified by varieties, 1935-36 season; exports by sea of Indian raw cotton classified by varieties, 1935-36 season.

375. SPINNING TEST REPORTS ON INDIAN COTTONS, 1936-37. By N. Ahmad. (*Tech. Circs. Nos.*, 270-4, 276-8, 1936-37. Ind. Cent. Cott. Comm.) The circulars contain the grader's report and spinning test results for Bengals, Khandesh, Ujjain, and Moglai cottons, and the report of the Standards Committee and spinning test results for Berar, C.P. No. 1, and Khandesh cottons for the 1936-37 season.

376. SPINNING TESTS ON MIXTURES OF STAPLE FIBRES AND INDIAN COTTONS. By N. Ahmad. (*Tech. Bull.*, Ser. A., No. 36. Ind. Cent. Cott. Comm., 1937.) An account of spinning tests carried out on two selected cottons—Cambodia Co.2 and Jayawant—and three types of staple fibre of about 1·5 deniers per filament and of staple lengths of 1·20, 1·32, and 1·44 inches respectively. Staple fibre is coming rapidly into use. It can be mixed with cotton, etc., the great disadvantage being its weakness when wetted, as in dyeing. It is considered that a small admixture with cotton might be useful in reducing breakages and neppiness, and improving the evenness.

377. TECHNOLOGICAL REPORTS ON INDIAN COTTONS, 1936-37. By N. Ahmad. (*Tech. Circs. Nos.* 267-9, 275, 279-80. Ind. Cent. Cott. Comm., 1936-37.) The particulars given include agricultural details, grader's report, fibre particulars, spinning tests and remarks, and conclusions.

Verum 262 (*Akola*). The fibre-length of the 1936-37 sample is slightly shorter, but more regular than its predecessor. Suitable for 23's warp.

V. 434 (*Akola*). Slightly neppy. Suitable for 27's warp.

Umri Bani. Area under cultivation 737,410 acres. Suitable for 30's warp.

Verum 262 (*Nagpur*). Area under cultivation 70,000 acres. Suitable for 25's warp.

Late Verum (*Nagpur*). Area under cultivation 29,000 acres. Somewhat neppy. Suitable for 31's warp.

Punjab-American 289F. Very neppy. Suitable for 44's warp.

378. TECHNOLOGICAL REPORTS ON TRADE VARIETIES OF INDIAN COTTONS, 1936. By N. Ahmad. (*Tech. Bull. No.* 35, Ser. A., 1936. Ind. Cent. Cott. Comm.) The grader's report and spinning test results are given for 26 representative trade varieties of cotton supplied by the East India Cotton Association, 20 varieties by the Bombay Millowners' Association, and 3 by the Ahmedabad Millowners' Association.

379. MADRAS: *Cotton Cultivation,* 1935-36. (*Rpt. of Operns. of Dpt. of Agr., Madras,* 1935-36.) The Cambodia strains 920 and 1267 continued to show superiority over Co.2, and were multiplied up for distribution. In crosses made between Co.2 and South African cotton cultivated on a plot scale, four were earlier than Co.2 by one month, but gave similar yield. These results give promise of securing a cotton which will enable ryots to adopt the necessary close period between successive cotton crops suggested by the Department of Agriculture. The total area under improved Cambodia strains was estimated at 213,339 acres, compared with 121,466 acres last year.

The Cotton Ginning and Pressing Factories Act continued in force. Seventeen new ginning factories were established during the year, making a total of 617. The number of pressing factories rose from 67 to 70. The question of amending the Act by a suitable Bill for Madras in order to prevent the mixing and watering of cotton was under consideration. The enforcement of the Cotton Control Act prohibiting the cultivation and mixing of *pulichai* (*G. neglectum*) cotton and its sale was extended for a further three years.

380. STUDIES IN CROP ECOLOGY. I. THE COMPOSITION OF THE COTTON CROPS OF CENTRAL INDIA AND RAJPUTANA. By J. B. Hutchinson and R. L. M. Ghose. (*Ind. J. Agr. Sci.,* vii., **1,** 1937, p. 1.) The past history and present status of the cotton crop in Central India have been investigated in an attempt to discover the causes and estimate the extent of the deterioration which it is believed to have suffered. As opportunity offered, information on the Rajputana crop was also collected, and is discussed. It is shown that the opinions of the local industry and the theories offered by agricultural authorities are not supported by the facts. The cotton of Malwa, concerning which most complaint has been made, has suffered no more deterioration than can be accounted for by its spread to less suitable land consequent upon an enormous increase in the area cropped with it. Invasion of *Roseum,* which was supposed to have caused the deterioration, has in fact occurred to only a very small extent, *Roseum* at present constituting only about 5 per cent. of the mixture. In Nimar, where deterioration has attracted much less attention, the quality of the cotton produced a century ago was greatly superior to that of Malwa. Invasion by *G. arboreum* var. *neglectum* forma *bengalensis* has taken place in response to the demand for high ginning percentage, and has resulted in deterioration in quality until the crop to-day is markedly inferior to that of Malwa. The trade evidence for deterioration is discussed. It is concluded that no adequate allowance has been made for short-period seasonal fluctuations. Much of the deterioration also is deterioration in grade and not in the intrinsic quality of the staple. Trade opinions, if carefully analysed, agree on the whole with the results of the crop studies, and show that the best lots of Malvi cotton are as good as ever, while the amount and variability of inferior qualities have increased.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

381. The following reports have recently been received:
British Cotton Association: Ann. Rpt., 1936.
Imperial Bureau of Soil Science, Rpt. for 1936-37.
Imperial Institute: Ann. Rpt. for 1936.
British Guiana: Agr. Jour., vol. iii., No. 1, 1937.
Fiji: Agr. Jour., 1936.
Gold Coast: Handbook, 1937.
Queensland: Ann. Rpt. Dpt. of Agr. and Forests, 1935-36.
Southern Rhodesia: Rpt. of Secy. Dpt. of Agr. and Lands, 1936.
Swaziland: Ann. Rpt. of Soc. and Econ. Progress, 1935.
West Indies: *St. Vincent,* Rpt. of Agr. Dpt., 1935.

382. British Cotton Growing Association. The thirty-second Annual Report for the year ended December 31, 1936, contains the usual valuable information on the Association's work in India and in other parts of the Empire. Full details are given of the work of the B.C.G.A. (Punjab), Ltd. Sections devoted to individual countries follow, and attention is drawn to the exports of cotton from Uganda which, at 321,348 bales, constituted a record. The production of cotton in Kenya Colony was double that of any previous year, and a further increase in 1937 is anticipated. In conclusion it is stated that "once again Empire cotton production has exceeded all previous records, and the approximate estimate of the cotton grown and produced in Empire fields has reached the formidable total of just over three-quarters of a million bales. . . . Throughout the year there has been a growing improvement in certain sections of the cotton trade, and for the last few months a real recovery has been witnessed. . . . The outlook is distinctly more promising than it has been for some years, and with loyalty to agreements and peace in the world a period of good trade is more than probable."

383. The Improvement of Native Agriculture in Relation to Population and Public Health. By Sir A. Daniel Hall. (Pubd. by Oxford Univ. Press, 1936. Price 10s. 6d. net.) The Heath Clark lectures delivered by Sir Daniel Hall at the University of London in 1935 are published in book form under the above title. In the preface the author states that he has "endeavoured to outline on a fundamental scientific basis the means by which the African tribes can be given a higher standard of living and be relieved of the pressure of over-population, of the incidence of much preventable disease, and of the imminent menace of the destruction of their land."

In the opening chapter the necessity for the maintenance of soil fertility is stressed, and the farming systems obtaining in different parts of the world are surveyed. It is pointed out that owing to the maintenance of high fertility in Chinese soils, one person can be maintained by one-sixth of an acre of land. Even in Denmark, the most intensively cultivated area in Western Europe, 1¾ acres are required; this is, however, due to cost of labour, which in its turn is dictated by the standards of living. The evils of shifting cultivation are then described, and possible ways of changing to rotations or mixed cropping are considered, together with the Indore composting system of Howard and Wad. The author passes on to the problems of overstocking and soil erosion, and draws attention to the necessity for the elimination of excessive live stock and the reconditioning of areas devastated by overgrazing. An interesting chapter on native dietary follows, pointing out the inadequacy of the native diets and the amount of deficiency disease prevailing. The only remedies are a better system of native farming and the growing of more leguminous crops. To carry out all these tasks education, propaganda and administrative action are essential, and in these Administrative and Agricultural Departments must work in close co-operation if success is to be achieved.

384. ASIA. CYPRUS: *Cotton Industry*, 1936. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1935-36, issued 1937.) Planting was delayed by the fact that the spring rains were late, and was then impeded owing to their being unduly heavy. Damage by both pink bollworm and spiny bollworm reduced the quantity and also lowered the quality of the crop. The quality of Cyprus cotton suffers from the use of mixed seed and from careless picking. The Dept. of Agriculture is providing pure seed in the most important cotton-growing districts in 1937, and is carrying out propaganda with a view to improving the standard of cleanliness in picking. A trial shipment to the United Kingdom of the highest yielding variety, Mesowhite, realized satisfactory prices.

385. AFRICA. TRANSPORT IN EAST AFRICA. (*Crown Colonist*, March, 1937, p. 138.) The Report on Co-ordination of Transport in Kenya, Uganda, and Tanganyika Territory, by Brig.-Gen. Sir H. Osborne Mance, has recently been issued, and the following is a summary of the more important conclusions:

"Unrestricted competition between transport undertakings is ruled out as a solution of the problem, and some form of regulation of the exercise of transport must be regarded as inevitable. The present railway system in East Africa is essential as the cheapest form of transport for imports and exports. Division of function, on the basis of cost to the community, should be primarily determined by out-of-pocket costs of working. It is assumed that in principle import traffic should continue to pay high rates in order that export traffic may continue to be charged low rates. This can only happen either by monopoly or by direct Government action. The solutions of a combined transport monopoly, a common financial pool, or a toll payment to the railways, while theoretically sound, are not generally applicable to East African conditions. The solution envisaged is a continuation of the present policy of protecting the railway monopoly, modified by elements from the other solutions to impart flexibility and to permit of gradual adaptation to changing conditions. Steps should be taken to reduce the highest railway rate to 50 cents per ton-mile, the necessary compensation being found either by raising the lower class rates, other than those export rates which are based on world prices, or by a Customs primage on the principal imports benefiting from the reduction of the railway rates, or by a combination of these methods. The control of all forms of transport by licensing is recommended. It is considered that, in present conditions, there is no need to restrict the operation of dhows on Lake Victoria. A monopoly of local air service in East Africa, with railway participation, is recommended. The policy suggested for road improvement is to concentrate on real all-weather main roads for vehicles of moderate size, and only later on to improve the principal trunk roads for heavier vehicles. Feeder roads should be given priority over roads parallel with the railway, but sooner or later good roads between important centres will be justified by the claims of passenger traffic alone. Other recommendations and proposals include an executive Transport Commission of five independent members for each territory, an Advisory Transport Committee to the East Africa Transport Policy Board, consisting of two delegates from each of the Transport Commissions, and revised arrangements for the division of certain traffic."

386. MIXED FARMING IN EAST AFRICA: (*E. Afr. Agr. J.*, ii., 4, 1937, p. 319.) *IV. The Value of Native Stocks.* (H. C. W. Guy.) Some notes on the Baraton herd of Nandi cattle. (*Cf.* Abstr. 261, Vol. XIV. of this Review.)

387. THE GOLD COAST HANDBOOK, 1937. (Obtainable from Crown Agents for the Colonies, Millbank, Westminster, S.W. 1. Price 7s. 6d. net.) We have received a copy of this informative and well-illustrated publication. The various chapters deal with the geography and history of the Gold Coast; climate and meteorology; ethnology, population and religion; government; production—agriculture, livestock and game, forestry, geology and minerals, native industries ; commerce; communications and transport; banking, currency, weights and measures; public finance and taxation; education; justice; military forces; public health; land tenure; Civil Service, etc. A useful chapter is included for the benefit of the newly-appointed officer, giving information regarding living conditions in the Colony, housing accommodation, suggestions for an outfit, health hints, and other matters. Appendices are included giving statistics of trade and finance, and information regarding stamp duties, fees, licences, postal matters, cable rates, etc. The publication contains a good map of the Gold Coast, and is furnished with an index.

388. NYASALAND: *Cotton Industry,* 1935-36. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.,* 1935-36.) Owing to very unfavourable weather conditions and to other causes the season was the worst in the past thirty years, and the crop fell far short of early estimates. In the Lower River area, where most of the crop is produced, in addition to adverse climatic conditions, the cotton was planted at a date which was too early in any but a dry season. The object was to avoid stainers later in the season, but the result was heavy damage by bollworm and a reduction amounting almost to elimination in the length and efficiency of the close season. It is hoped that this will be rectified in the future. The other cotton-growing areas also suffered badly through the heavy rains in February and March, followed by drought for the rest of the season; partial famine threatened, and the natives, therefore, rightly gave prior attention to securing their food supplies.

The areas in which cotton is grown are extending. On the Lilongwe Plateau cotton is suggested as a substitute for dark tobacco, the market for which is believed to be approaching saturation point. Experimental plots have been tried there in the past two years with satisfactory results, but confirmation on a larger scale is needed before the crop is started on a commercial basis. There is also a possibility of extending the growing of cotton in the North Nyasa district.

389. *Cotton Prospects,* 1936-37. A recent report from H.M. Eastern African Dependencies Trade and Information Office is to the effect that in the North-Central belt 294 tons of seed were issued to 14,500 growers. The bulk of the crop was planted in January and progress has been good. Cotton is disappointing generally in South Nyasa, but is promising well in eastern Mlanje. 1,050 tons of seed were issued to growers in the Lower River areas. It was put in under excellent conditions, but has suffered severely since, and much replanting has been necessary.

390. NORTHERN RHODESIA: *Cotton Industry,* 1935-36. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.,* 1935-36.) The Government continued their programme of growing test plots of cotton in areas of different soil types with a view to developing the crop in certain native areas. The plots in some parts did well and would have yielded 600 lb. seed cotton per acre, had it not been for abnormally early frosts, which halved the yields. Even so, at present prices the best plots would give the cultivator a return of 25s. an acre as against 15s. for maize. A small station was started at Pemba to demonstrate the advantages of a rotation of maize, cotton and beans. The possibilities of Barotseland for growing cotton commercially have been reported on, and though a large output is not to be expected, the country is considered to be worth a trial.

The principal piece of work last season at the Mazabuka Research Station was the continuation of the interesting records of the population of different species of stainers on cotton and on various wild host plants. This work, like the insect pest control work in Southern Rhodesia, is linked up with that which is being done at the Corporation's main Station at Barberton, South Africa.

This season (1936-37) some 200 natives altogether planted cotton in various parts of Northern Rhodesia, and in addition several Missions are growing plots at their native schools. It is possible, therefore, that this year may see the start of a small native industry of cotton-growing for export.

391. SOUTHERN RHODESIA: *Cotton Industry,* 1935-36. (*Rpt. of Sec. Dpt. of Agr. and Lands,* 1936.) The rains arrived very late in the cotton-growing districts, with the result that the acreage planted by farmers was small. The season, however, turned out better than was expected, and the final yields were generally satisfactory. A definite though small advance was recorded in the amount of cotton grown by natives, but no serious effort was made to induce many to grow the crop as it was not certain that adequate facilities would be available for its purchase in time. Only twenty-one natives planted cotton last season, but since definite arrangements have now been completed to buy all the cotton grown and to pay cash for it, an increasing number may be attracted to it; already more than seven times as much seed as last season has been distributed. At the Gatooma Station further progress was made in the breeding of improved cottons, and in addition date of sowing and thinning experiments and manurial and fertilizer trials were carried out. The work in connection with insect pest control was continued in co-operation with the Barberton Station. The chief pests encountered during the season were American and Sudan bollworms, stainers and jassid. The Cotton Research and Industry Act came into being on July 24th. The Board created by this Act will supervise research work on cotton and on insect pests and diseases, and will assist in every way the development of the cotton industry in the Colony.

392. *Cotton Industry: Prospects for* 1936-37. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.,* 1935-36, issued 1937.) The season has been so far the most favourable for cotton for many years. On many farms the crop was looking very well at the end of March, and the good season and better prices were causing more interest to be taken in cotton.

393. SOUTH AFRICA: *Cotton Industry,* 1935-36. (*Rev. of* 1935-36 *Cotton Crop.*) The season was the latest which has been recorded in the last twelve years. Following approximately ten months which were virtually rainless, planting rains did not materialize until mid-January. Succeeding conditions for growth were good, but pest infestation in many areas was somewhat severe. Yields from irrigated areas were satisfactory. An invasion of jassid in the Orange River area fortunately appeared too late to cause material damage.

Prospects for 1936-37.—Owing to the advance in price and steadiness of the cotton market, a larger acreage has been planted throughout all areas. Good and general planting rains have been experienced, and the prospects are very favourable.

394. A REVIEW OF THE CO-OPERATIVE MOVEMENT IN SOUTH AFRICA. By J. J. Adams. (*Bull. No.* 176, Div. of Econ. and Markets, S. Africa, 1937.) *Cotton Co-operative Companies.*—There are five local cotton companies and a central company which sells cotton delivered to the local companies in the Union as well as cotton grown in Swaziland and Rhodesia. As a group, the financial position of the societies can be considered as satisfactory. About 55 per cent. of the cotton output of the Union and Swaziland is marketed co-operatively, but until cotton production increases, there appears little prospect of the companies improving their positions.

395. SWAZILAND: *Cotton Cultivation,* 1935. (*Ann. Rpt. of Soc. and Econ. Progress of the People of Swaziland,* 1935.) In view of the locust invasion in the earlier part of the year smaller areas were sown to the various crops, and some of these were partially destroyed by locusts. The rains due from September onwards were late, and consequently planting for the next season was retarded. Cotton and tobacco are becoming increasingly popular as cash crops among natives, the cultivation of the former crop being encouraged by the Empire Cotton Growing Corporation, who have a station at Bremersdorp. These crops were the least affected by locusts, but the adverse weather conditions militated against the production of large harvests. Labour was plentiful for all purposes throughout the year.

Motor Transport.—The motor transport services of the South African Railways Administration and the Portuguese East African Administrations, carrying both goods and passengers, continued to operate over the same routes as formerly between Swaziland and the railheads in the neighbouring territories. The charges by both services were the same: passenger fares 2d. per mile for Europeans and 1½d. per mile for natives; charges for goods carried were on a sliding scale and according to classification, viz. from 3d. for 5 miles to 2s. 6d. for 100 miles per 100 lb.

396. SUDAN: *Cotton Industry,* 1935-36. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.,* 1935-36.) The Gezira crop was sown under rather less favourable conditions than those of the previous season. Blackarm was more prevalent and a slight recrudescence of leaf curl reduced the yield in localized areas. Approximately one-third of the total area was sown with X1530 cotton, which is highly resistant to leaf curl attack. Ginning outturns from all grades and varieties of cotton were exceptionally good. At Tokar the 1935 flood was one of the poorest experienced for many seasons. The whole delta was sown with X1530 and X1530A cotton, and the final yield was very satisfactory considering the adverse weather conditions experienced. The quality of the cotton was good. In the Gash area the flood was erratic in flow, some areas being inadequately watered. Losses were also caused by pink bollworm damage and cattle trespass. The output of rain-grown cotton in the Southern areas showed a decrease on the previous season's record figure.

Season 1936-37.—In the Gezira area some 200,000 feddans were planted to cotton. The 1936 rainfall was erratically distributed. Blackarm was generally distributed as a light infection, but the crop has since made a good recovery and a yield above the average is anticipated. At Tokar and in the Gash area the 1936 flood was a good one, and the prospects of the current crop are promising. In the Southern rain-grown cotton areas the 1936 rains were much more satisfactory, and the area under cotton has been extended; some difficulty is being experienced, however, in obtaining an adequate supply of picking labour. Two further ginneries have been constructed in this area. The introduction of the "513" type of American cotton in the Southern pump schemes of Northern Province has led to considerable improvement this season.

397. TANGANYIKA TERRITORY: *Cotton Industry,* 1935-36. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.,* 1935-36.) In the Northern and Tanga Provinces heavy rains during July to September seriously affected the cotton plants; nevertheless the total output from these two provinces was a record. In the Eastern Provinces, owing to adverse weather conditions, yields were less satisfactory, but in the Bagamoya and Rufiji districts the crop exceeded all past records.

The Kilosa district also did well despite a plague of rats, in combating which over half a ton of poison was used. In the Lake Province, where most of the cotton in the Territory is produced, weather conditions were generally good and normal yields were obtained. In the Central Province cotton was introduced into the valley lands of the densely populated Singida district with satisfactory results. At the various Experiment Stations much important work was carried out which should prove invaluable in laying the foundations of a sound and tested system of agriculture adapted to the conditions of the districts in which the Stations are severally situated.

398. *Cotton Prospects*, 1936-37. (*Crown Colonist*, May, 1937, p. 230.) Welcome rains have fallen along the coastal belt, and have come just in time to save the cotton crop, but sisal has suffered considerably from drought. Draft legislation has been issued revising the cotton rules.

399. UGANDA: *Cotton Industry*, 1936-37. (*Crown Colonist*, May, 1937, p. 229.) The crop is estimated at 330,000 bales, which constitutes a fresh high record. The cotton market has shown extraordinary fluctuations, and the native grower has benefited substantially by the rise. Prices recently ranged from Sh. 16 to Sh. 17 per 100 lb. of good raw cotton. On the other hand, the cotton-seed market weakened from 55s. at the opening of the season to 45s. per ton f.o.r.

400. EXPERIMENTS ON THE MAINTENANCE OF SOIL FERTILITY IN UGANDA. By W. S. Martin and C. E. J. Biggs. (*E. Afr. Agr. J.*, March, 1937, p. 371.) The evils of shifting cultivation and of soil erosion are discussed. With a view to maintaining the fertility of the soil the authors have drawn up a comprehensive scheme of experiment to discover: (1) the minimum period of rest necessary to maintain fertility; (2) the best type of cover during rest; (3) the effect of green manuring; (4) the dosage of animal manure necessary in conjunction with the above; (5) the relative effects of ploughing and hand-cultivation on soil erosion; (6) the best simple anti-erosion measure compatible with peasant farming.

401. AUSTRALASIA. QUEENSLAND: *Cotton Industry*, 1935-36. (*Ann Rpt. of Dpt. of Agr. and Stock*, 1935-36.) As a result of the Federal fiscal policy, the Australian cotton market is improving rapidly. The new system of payment on the basis of lint instead of seed cotton has been advantageous to the grower and the industry generally. Better farming practice was reported from every cotton district, especially in regard to crop rotation. In contrast to the previous season, pest and disease injury was more serious, the crop being attacked by web-spinner, cutworm, corn-earworm, jassids, pink bollworm, Rutherglen bug, and by angular leafspot. At the Cotton Research Station the determination of suitable varieties for a wide diversity of soil types was an important phase of the field experimentation work carried out in the course of the year. New strains of the leading varieties in cultivation were evolved. Extension and advisory services, in addition to experimental work, contributed materially to the progress of the industry during the year, and personal contact with growers by means of meetings of producers and farm-to-farm visits was regularly maintained.

402. *Cotton Industry*, 1935-36. (*Ann. Rpt. Queensland Cott. Board*, 1936.) Conditions were good and the crop from 60,000 acres, grown by 3,364 growers, was harvested early, giving over 13,000 bales of 500 lb. The pickers' claim for increased wages was granted to some extent, and against the wish of many growers. Of the total of bales, 4,905 were Lone Star cotton. Lint percentage was 34·658. The staple is changing from long to medium varieties in response to the demands of spinners: 46·64 per cent. of the crop had a staple of 1 inch. A number of more general features of the cotton market are then dealt with in the report.

403. *Cotton Prospects,* 1936-37. (*Queensland Agr. J.*, January, 1937, p. 69.) Owing to the lateness of arrival and the light nature of the rainfall in some districts less cotton will be planted this season. In localities, however, where the early rainfall allowed the crop to be started off in the normal planting season, excellent progress has been made. Fortunately, an increased area of the quicker-maturing varieties has been planted this season, which should help to overcome the delayed start to a marked extent.

404. THINNING AND SPINNING OF COTTON. By W. G. Wells. (*Queensland Agr. J.*, February, 1937, p. 219.) The results of experiments indicate that for alluvial soils with varieties of cotton such as Indio Acala, Miller, New Boykin, Ferguson, and Half-and-Half, the most satisfactory spacing is 12 to 15 inches. The Durango variety, with its tendency to develop more of a top crop on the large vegetative branches, requires 20 to 24 inches spacing. On the harder, less fertile clays and clay loams of the forest slopes, more drought-resistant, vigorous-growing types like Lone Star and Mebane require 20 to 24 inches spacing. The results of time of thinning experiments indicate that the best time to thin is when the plants are 5 to 8 inches tall.

405. FIJI: COTTON BUYING AND GINNING. By B. Lyon Field. (*Agr. J. Fiji*, viii., 2, 1936, p. 14.) Efforts to resuscitate the cotton industry locally are in operation, and certain sections of the people appear to be definitely interested. In this paper the author records some of the difficulties encountered in buying seed cotton and in ginning it. The recent adoption of single unit ginneries, and the reduction of four grades for seed cotton to two grades, have already shown that cultivators appreciate these changes.

406. WEST INDIES. *The Cotton Industry,* 1935-36. (*Trop. Agr.*, xiv. 4, 1937, p. 119.) The area planted to Sea Island cotton amounted to 12,387 acres, approximately 4,320 acres more than the previous season. The increased acreage was planted chiefly in St. Vincent, Nevis, and St. Kitts. Production was more evenly distributed between the islands. In recent years Montserrat produced approximately two-thirds of the total crop, but in 1936, mainly owing to disease resulting from unfavourable weather conditions, the yield fell to less than one-third of the total production. On the other hand, in St. Vincent, Nevis, and St. Kitts, where weather conditions were generally favourable, the yield was more than doubled. The total production of Sea Island amounted to 3,694 bales of 400 lb., and of Marie Galante to 871 bales. Prices on the whole were better than the previous year, averaging 3d. to 6d. per lb. lint higher, the maximum price being about 1s. 10d. per lb. lint.

Production for the 1936-37 season is estimated at 5,240 bales of Sea Island and 746 bales of Marie Galante.

407. THE SEA ISLAND COTTON INDUSTRY. By W. N. Sands. (*W. Ind. Comm. Circ.*, March 11 and 25, 1937, pp. 83 and 107.) An interesting account of the successful re-establishment of the Sea Island cotton industry in the British West Indies at the beginning of this century, and of some of the problems in connection with pests and diseases which have to be solved.

408. MONTSERRAT: *Cotton Cultivation—Change of Planting Date.* (*W. Ind. Comm. Circ.*, 11/2/37, p. 48.) The cotton-planting season in the island has hitherto opened on the last Saturday in February and lasted until the end of May. Last year a dry spell in March and April resulted in a large proportion of the cotton not being established until the end of May, and the abnormally heavy rains of July-September led to so great an increase in the various pests that the crop was only about one-third of the estimate. To avoid a repetition of such an occurrence it was decided to retard the cotton-planting season in order that the crop might be mature before the advent of the heavy rains in the hurricane season, and the opening planting date has been fixed for February 1.

409. THE SEA ISLAND COTTON INDUSTRY IN ST. KITTS, NEVIS, AND ANGUILLA. By R. E. Kelsick. (*Rpt. of 4th Ann. Gen. Mtg. of the W. Ind. Sea Is. Cott. Assn.*, 1936.) An informative paper dealing chiefly with matters affecting the industry during the period 1925 to 1936. Statistics are given of acreage, production, prices, exports, etc., and pest control, ginneries, and the marketing of the crop are discussed.

410. ST. VINCENT: *Cotton Industry*, 1935-36. (*Rpt. on Agr. Dpt.*, 1935, recently received.) The area under Sea Island cotton was 3,540 acres and under Marie Galante 721 acres, compared with 1,464 acres and 652 acres respectively for the previous year. Germination was excellent and very good stands were obtained. Fungus diseases (probably caused by a species of *Rhizoctonia*) and mole crickets were very destructive. The manuring of cotton received much more attention, and many peasants as well as planters applied varying quantities of sulphate of ammonia with or without an additional application of cottonseed meal when the plants were about 4-6 weeks old, and in general growth of the plants was good. Very successful results were obtained from two cotton manurial experiments laid down by the Dept. of Agriculture. The increase from a dressing of 3 cwt. of sulphate of ammonia per acre was considerable, yields from control plots and sulphate of ammonia plots being 1,257 lb. and 2,000 lb. of seed cotton per acre respectively.

At the Cotton Experiment Station the regular reproduction of good seed was carried on. In connection with V.135, the staple length now being a fixed character, attempts were made to increase the yield by straight selection of strains with higher weights of lint per seed and a greater number of bolls per plant. The 42 strains of Red Sea Island cotton grown were all pure for red body, weak spot and superfine length, and maintained their superiority over V.135 in weight of boll contents and ginning outturn. V.135 is still, however, superior in number of bolls per plant and number of seeds per boll. A lint measurement of 70 mm. from one of the selections indicated that Red Sea Island may possibly now be as good as V.135 in spinning value. The growth of the Montserrat-V.135 strains was disappointing owing to dry conditions at the end of the season. Notwithstanding, some good selections were carried forward, including some with intermediate length staple (53-55 mm.) and short staple (50-52 mm.).

411. *Cotton Prospects*, 1936-37. A note on the cotton crop for the quarter ended March 31, recently received from the Superintendent of Agriculture, states that the exceptionally heavy rainfall in January caused serious damage to bolls, due chiefly to external boll diseases, and a loss of 20 per cent. of the crop is estimated. Cotton stainers have not been numerous anywhere, but the incidence of pink bollworm has been considerably higher than usual.

COTTON IN EGYPT.

412. STRENGTH OF EGYPTIAN COTTONS. By H. A. Hancock. (*Int. Cott. Bull.*, xv., **58**, 1937, p. 275.) A summary of tests on strength, taker-in waste, hair weight, staple length, and the average spot price for Sakel, Sakha 4, Maarad, Giza 7 and 12, Uppers, and Zagora cottons of the 1934 and 1935 crops.

413. COTTON ROADS IN EGYPT. (*Int. Cott. Bull.*, xv., **59**, 1937, p. 462.) An English road engineer has made experiments in Alexandria with cotton cloth roads, and it is stated that they are proving quite satisfactory, as there are signs that they are standing up well to the traffic. It has also been found that these cotton roads coated with bitumen are very much quieter than the old roads which they have replaced. The roads are not subject to heavy traffic, but the usual Egyptian traffic such as donkey carts, camels, etc.; the carts, however, are usually shod with thin iron hoops. Cotton cloth coated with bitumen is also being used to cover the flat Egyptian roofs in order to make them waterproof. Similarly, experiments with bitumen-coated cotton cloth to prevent damp from percolating through walls have proved their usefulness. In the East flat roofs are used exclusively and this outlet for cotton cloth should be of considerable importance.

COTTON IN THE UNITED STATES.

414. U.S. Yearbook of Agriculture, 1936. (Obtainable: Supt. of Documents, Washington, D.C. Price $1.25.) We have recently received a copy of this monumental work. Though dealing with American agriculture generally, this yearbook contains so much material about cotton and its breeding that it is quite indispensable in any institution concerned with that crop. The whole book is devoted primarily to breeding, and the cotton section (by J. O. Ware, Senior Agronomist) occupies some 88 pages. Varieties of cotton, the effects of the boll weevil and of foreign competition, are first mentioned, and it goes on to details of breeding from over a century ago. Each Station has its work considered separately, and improvement abroad is outlined. In an appendix the origin, the breeding, and the characters of many varieties of cotton are described in detail. Other crops equally well treated include wheat, barley, oats, rice, corn, sorghum, sugar cane, sugar beet, flax and tobacco. A useful inclusion in the volume is a glossary of genetic terms. Altogether a most informative publication.

415. Agricultural Statistics, 1936. (U.S. Dpt. of Agr. Obtainable: Supt. of Documents, Washington, D.C. Price 50 c., paper covers.) This invaluable publication, prepared under the direction of the Yearbook Statistical Committee, contains statistics of grains; cotton, sugar, tobacco; fruit and vegetables; miscellaneous crops; beef cattle, hogs, sheep, horses, and mules; dairy and poultry statistics; statistics of foreign trade in agricultural products; farm business and related statistics; miscellaneous agricultural statistics—forestry, weather, roads, etc. A useful index is included.

416. The Distribution of American Raw Cotton, Season 1932-33. By J. W. Wright and J. H. McLure. (U.S. Dpt. of Agr., Bur. of Agr. Econ., Washington, D.C., January, 1937.) Although dating back five years, this is a very useful study, with numerous graphs and tables. The study was undertaken "in an attempt to meet the need for more definite quantitative data relative to the market geography of American raw cotton. The major objectives were (1) to delimit the areas of supply and distribution of all of the cotton ports and some of the important interior markets under the existing transportation rate structure; (2) to indicate the relative importance of various modes of transportation and types of bales involved in the distribution of American raw cotton; (3) to ascertain the places of consumption of cotton produced in the various sections of the Cotton Belt and, conversely, the origins of cotton consumed in various mill centres."

417. Improved American Cotton: Cultivation. (*Cotton M/c*, 42, 2047, 1937, p. 9.) Excellent results continue to be secured from Acala and Lone Star. These two cottons, with the strains developed from them, are now annually planted on more than 1,000,000 acres in the Cotton Belt. Hopi cotton has a staple only $1\frac{3}{16}$ in. long, but approaches Sea Island in fineness and produces a yarn as strong as that made from $1\frac{5}{32}$ in. Upland cottons. The $1\frac{1}{8}$ in. fibre from a first-generation cross between Acala and Hopi produced a yarn as strong as that derived from $1\frac{1}{2}$ in. Upland cotton. Interest in Sea Island has increased, and some 4,000 acres were planted in 1936. Studies are being made of hybrids between Sea Island and Upland long-staple varieties. A selection from the Tidewater variety of Upland cotton is much more productive than Sea Island, has bolls about twice the size, and produces a fine quality of fibre 1¼ in. long. The stock is being further selected and used in hybridization work with Sea Island. Improved strains of Meade are also being developed. Some 10,000 acres were planted in 1936 with the S × P variety derived from a cross between Sakel and Pima cottons.

418. Rates for Ginning and Wrapping American Cotton and Related Data, Seasons 1928-29 to 1935-36. By J. W. Wright and W. B. Lanham. (U.S. Dpt. of Agr., Bur. of Agr. Econ., Washington, D.C., January, 1937.) Average charges for the entire Cotton Belt for ginning and wrapping Upland cotton declined from $5.96 per 500 lb. gross weight bale in 1928-29 to $4.12 in 1931-32. Since then rates have increased gradually. They averaged $5.04 per bale during the seasons 1934-35 and 1935-36.

Rates for ginning and wrapping American-Egyptian cotton averaged $17.21 per 500 lb. gross weight bale for 1928-29 and 1929-30. The rate declined to $11.06 per bale for 1931-32, but increased later, the average rate for 1935-36 being $12.72.

The quantity of seed cotton required for a standard-weight bale of lint depends primarily on the variety of cotton grown and the method of harvesting used. For hand-picked cotton the average for the 1934-35 season for all cotton-producing States was 1,423 lb. of seed cotton per 500 lb. gross weight bale. The average for snapped cotton was 1,972 lb., for bollies 2,242 lb., and for sledded cotton 2,589 lb.

419. American Cotton Linters, Production and Quality. By V. R. Fuchs. (*U.S. Dpt. Agr. Rpt.*, July, 1936. From *J. Text. Inst.*, xxviii., **1**, 1937, A60.) Surveys of the quality of linters produced in the U.S.A. were made in January, 1934 and 1935, the official standards being applied. The results for the two seasons are tabulated and discussed, and production data are recorded for each State and for each of the seven grades. The total production (1934-35) was 805,083 bales; 3,550,000 tons of cottonseed were crushed and 142 lb. of linters cut per ton, 19·5 per cent. being "first cut," 32·0 per cent. "mill run," and 48·5 per cent. "second cut."

420. American Cotton Textile Institute: Foundation and Work. By D. G. Woolf. (*Text. World*, **86**, 1936, p. 2105. From *J. Text. Inst.*, xxviii., **1**, 1937, A55.) An account is given of the foundation and development of the Cotton Textile Institute of America which was established in 1926. For several years after its formation the activities of the Institute were mainly concerned with statistics, costs and new uses for cotton goods. Since 1930 the Institute has also studied management policies, advised the industry in regard to hours of work, the elimination of night employment for women and minors, and other problems, and carried out negotiations between the industry and the Government. Various other miscellaneous activities are mentioned.

421. Alabama: *Hairy Vetch and Austrian Winter Peas for Soil Improvement—A Progress Report.* (*Alabama Sta. Circ.* 74, 1936. From *Exp. Sta. Rec.*, 76, **1**, 1937, p. 28.) Results are given of field tests, from 1930-35, to determine the merits of vetch or Austrian winter peas for increasing cotton and corn yields. Where cotton and corn were grown continuously on respective areas, vetch or Austrian winter peas turned under increased the yield of seed cotton 628 lb. and of corn 15·6 bushels per acre. The increase in cotton yield due to the legumes was worth $3.78 per acre net more than that from 225 lb. of sodium nitrate or its equivalent. Where continuous corn was preceded by one of these legumes the increased yield cost 16 cents per bushel. The legume in a two-year rotation (cotton-winter legume-corn) increased the corn yield 18 bushels per acre at a cost of 14 cents per bushel, and the residue in the second year from these legumes increased the cotton yield by 213 lb. of seed cotton. When inadequately fertilized with phosphate, these legumes usually failed to make enough growth to increase cotton and corn yields economically, and the reverse held true. To provide nitrogen enough for the succeeding crop, the tops of the legume should be ploughed under, since about 90 per cent. of the total nitrogen in the plant is in the tops at the proper time for turning. Essentials for the success of these legumes for soil improvement include early (September or October 1 to 15) planting, preferably drilled inoculated (at first time planting) seed at the rate of 20 lb. per acre of hairy vetch and 30 lb. per acre of Austrian winter peas; using 300 to 400 lb. of superphosphate or 600 lb. of basic slag unless the land has been well fertilized with phosphorus for several years; and turning under in the spring when the green tops from 100 square feet weigh 15 to 20 lb., delaying the planting of the succeeding crop at least two weeks afterward.

422. ARKANSAS: *Agronomic Research in* 1936. (*Forty-Eighth Ann. Rpt. of Agr. Exp. Sta., Arkansas,* 1936.) The work on cotton included fertilizer tests, varietal trials, breeding experiments, and fibre investigations. A brief account is given of a genetical, physiological and pathological study of cotton with special reference to wilt and the breeding of resistant varieties. Half-and-Half was the most susceptible variety tested. The use of potash fertilizers continued to prove efficient in controlling rust and cotton wilt. Results indicated that on land infested with the root-knot nematode, *Heterodera marioni,* both varietal resistance to cotton wilt and resistance resulting from the use of potash fertilizers were much less evident when root-knot was present. When either phosphate alone or in combination with sodium nitrate only was applied to lands where rust was present, both rust and cotton wilt were decidedly more severe than when no fertilizer was applied.

423. ARIZONA: *Field Crops Experiments,* 1935. (*Arizona Sta. Rpt.,* 1935. From *Exp. Sta. Rec.,* 76, **1**, 1937, p. 29.) Brief reviews are given on the progress of research with field crops, including breeding work and inheritance studies with cotton, and studies of certain factors influencing maturity and length of cotton fibres.

424. CONNECTICUT: *Report of Tobacco Substation at Windsor,* 1935. By P. J. Anderson *et al.* (*Conn.* [*New Haven*] *Sta. Bull.* 386, 1936. From *Exp. Sta. Rec.,* 76, **2**, 1937, p. 185.) *Further Fertilizer Experiments with Cotton-Hull Ashes.* —This series of tests, 1932-35, has shown that the use of a formula comprising cotton-hull ashes and cottonseed meal has produced excellent tobacco, which at least equals that grown with a similar formula containing other potash carriers. The use of cotton-hull ashes has not resulted in any greater accumulation of potassium, calcium, magnesium, phosphorus, or nitrogen salts in the soil in four years, and has had no influence on fire-holding capacity, nor were consistent differences observed in colour or coherence of the ash, width of coal band, or in the taste and aroma of the cigars. The slight increase in soil reaction was not injurious here and would not be dangerous except on soils with a naturally high reaction. Analyses indicated that the basic content of tobacco was not significantly changed by the use of cotton-hull ash.

425. FLORIDA: *Sea Island Cotton Cultivation.* By M. G. Barnwell. (*Text. World.,* **87**, 1937, p. 76. From *Summ. of Curr. Lit.,* xvii., **7**, 1937, p. 176.) The production of Sea Island cotton on the coastal islands off South Carolina and Georgia declined from 100,000 bales in 1917 to about 7 bales in 1933. The experiment station on one of the islands was closed in 1933, but about this time attempts were made to grow Sea Island in Florida, and a crop of 15 bales was picked in 1934. With improved methods of boll-weevil control a fair crop was expected in 1935, but storms reduced the yield to 165 bales. In 1936 about 900 bales were ginned in Florida and 70 bales in South Georgia. At least 10,000 to 12,000 acres in Florida will be put into Sea Island cotton this coming season, and the yield should be about 5,000 bales.

426. OKLAHOMA: *Field Crops Experiments*, 1934-36. By H. F. Murphy *et al.* (*Oklahoma Sta.* [*Bien.*] *Rpt.*, 1934-36.) Research work on cotton included varietal, breeding, time of sowing, and spacing tests. During the period under review severe losses were caused by cotton pests, including the salt marsh caterpillar, cotton flea hopper, cotton leafworm, garden webworm, and grasshoppers. The loss caused by these pests was estimated at 50,000 bales of cotton.

427. TENNESSEE: *Field Crops Experiments*, 1935. By H. P. Ogden *et al.* (*Tennessee Sta. Rpt.*, 1935. From *Exp. Sta. Rec.*, 76, **1**, 1937, p. 29.) The experiments with cotton included breeding work, varietal tests, lint studies, development of technique for measuring fibre properties, and pollen germination tests.

428. TEXAS: *Fertilizer Placement Studies with Cotton*, 1935. By H. P. Smith. (*Natl. Joint. Com. Fert. Appl. Proc.*, **11**, 1935, p. 67. From *Exp. Sta. Rec.*, 76, **1**, 1937, p. 11.) When fertilizer was placed 1, 2 and 3 inches underneath cotton seed at the time of planting, slightly better stands were obtained for the 3-inch placement, and slightly better yields for the 2-inch depth. Fertilizer placed 2·5 inches to each side and 1, 2 and 3 inches below the level of the seed gave results slightly in favour of the 2- and 3-inch depths. Disturbing the soil under the seed at the time of planting retarded germination regardless of whether or not any fertilizer was applied.

COTTON IN FOREIGN COUNTRIES.

29. COTTON GROWING IN ABYSSINIA. (*Int. Cott. Bull.*, xv., **57**, 1936, p. 32.) It is reported that an organization under the style of the Abyssinian Cotton Company has been formed with the object of growing cotton in Abyssinia, and thus to help Italy to become independent of foreign supplies. The registered office of the company is at Addis Ababa, and its capital is 2,000,000 lire, power being reserved to increase this to 20,000,000 lire. The Harar region is generally considered as one of the most suitable districts for cotton cultivation.

430. ARGENTINA: *Boletin Informativo.* (Pubd. by Min. of Agr. Junta Nacional del Algodon, Buenos Aires, Argentina.) Numbers 16, 18, 19 and 20 of this publication contain articles (in Spanish) on the factors that determine the area sown to cotton, the price of cotton, mechanical picking, and the contest with the pink bollworm, statistics of prices in Liverpool of American cotton, exports of cotton seed, etc.

431. *Censo Algodonero de la Republica Argentina*, 1935-36. (Min. de Agr. Pubn. No. 16, Buenos Aires, December, 1936.) A detailed account of the cotton industry in Argentina, with numerous graphic figures and tables of statistics, showing areas and rates of increase, acreages per farm, proportions of farms of different sizes in different districts, nationalities of farmers, and many other features.

432. *Cotton Varieties.* (*Int. Cott. Bull.*, xv., **58**, 1937, p. 197.) The Cotton Division of the Argentine Department of Agriculture has recently acquired a number of new cotton varieties from the cottonseed breeding firm of Coker, Hartsville, South Carolina, for cultivation in the new cotton zones of Sante Fé, Entre Rios and Cordoba. The most important varieties are Farm Relief No. 3, Coker Cleveland 5 No. 7, Coker's Wild No. 7, and Coker's Clevewild No. 4.

433. Belgian Congo: La Campagne Cotonnière, 1935-36. By M. Waelkens· (*Ser. Tech. No.* 10, Inst. Nat. Agron. Congo Belge, 1936.) Cotton selection work was continued at the Bambesa Station. Comparative studies were made with pure lines, 21 of Triumph, 26 hybrids and 6 new varieties, including S.G.29. The Triumph strains 145 and 270 retained their good qualities, and a selection No. 15 combined the qualities of both. Compared with that of the ordinary cotton the product of the progenies of the selected strains showed marked superiority, and the purity of the lines is becoming increasingly pronounced. Systematic roguing was practised on progenies in process of multiplication. Most of the varieties under observation at the station showed characteristic impurities. New crosses have been made between pedigree strains and an indigenous *barbadense* cotton.

434. La Bataille du Coton au Congo Belge. By E. Leplae. (*Bull. Trim. Com. Coton. Congolais*, i., **3**, 1936, p. 3.) A review of the economic and political history of cotton cultivation in the Belgian Congo. Cotton was not grown previous to 1914, but the crop of 1936 is estimated to reach 80,000 tons of seed cotton. There are 114 up-to-date ginneries installed in the Colony. The efficient regulation of the cotton industry is based on three chief points: (1) purchase of cotton by the factories at the price fixed by Government; (2) obligation on all able-bodied natives to cultivate a fixed area; (3) exclusive right of each factory to buy the native cotton within a definite radius.

435. Rapport de la Station de Selection Cotonnière de Bambesa. By G. Tondeur. (*Bull. Agr. du Congo Belge*, xxvii., **4**, 1936, p. 578.) The work was chiefly concerned with the multiplication of seed of the strain No. 145, which is now attaining considerable purity. Details are given of the work on this cotton at the Station, and the system of distribution to the natives.

436. Brazil. We have received a copy of the journal *Ouro Branco*, published in São Paulo, a state which is becoming a large producer of cotton. The present number contains articles (in Portuguese) on labour, pests, manuring, heat treatment of seed, etc., and useful tables of commercial statistics.

437. China: *Cotton Industry*, 1936. Chinese Cotton Statistics Assen., Shanghai. (*Int. Cott. Bull.*, xv., **57**, 1936, p. 21.) Statistics of area, and yield are given for the different provinces for 1935 and 1936. It is estimated that the 1936 crop will amount to 3,400,000 bales, compared with 2,600,000 bales last year; some 300,000 bales should be available for export.

438. The Textile Industries of China, their Present Position and Future Possibilities. By A. F. and K. C. Barker. (Pubd. by Chiao-Tung University, 1934. From *J. Text. Inst.*, xxvii., **10**, 1936, p. 358.) The report is devoted particularly to problems of technique, management, and labour in the manufacture of silk, cotton and woollen goods, and is primarily of interest to the Chinese authorities concerned. It contains, however, much first-hand information of local conditions and is of general interest in estimating the future of China as a competitive factor in the world textile markets.

439. A Study of Farm Economy in China through an Analysis of Farm Accounts in Selected Districts. By W. Tong and S. Tu. (*Agr. Sin.*, i., **12**, Nanking, 1936, p. 407.) An interesting account of farm economy in China. The striking features are the great amount of human labour as against farm animals or other aids, and the indebtedness of so many farmers, which is just like that found in India. It is stated that farm labour would be more efficiently utilized if the farmers would arrange to avoid competing crops.

440. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No.* 25, 1937, contains the following, among other papers: "La campagne cotonnière 1935-36 au Soudan"; "L'emploi des légumineuses dans les principales cultures tropicales"; "Le coton en Syrie"; "La production cotonnière au Soudan français." The usual notes on cotton in the French colonies and other countries, cotton marketing, etc., are included.

441. LE COTONNIER PIMA AU MAROC. By F. Heim de Balsac and E. Miege. (*Coton et Cult. Cotonn.*, xi., **1**, 1937, p. 21.) A comparison of agricultural and technological results obtained with Pima 67 cotton at three stations in the Belgian Congo in 1934 and 1935. Due probably to differing climatic conditions, the length of the cotton was 42 mm. in 1935 against 43 in 1934, and other characters, especially homogeneity, fineness, strength, etc., were also poorer; Pima 67 is, however, considered the most promising cotton for Morocco.

442. GERMAN COTTON YARN TRADE. By G. Braun. (*Wirtschaftsdienst*, **21**, 1936, p. 1641. From *J. Text. Inst.*, xxviii., **1**, 1937, A54.) Tables are given showing the distribution of cotton spindles, German and English cotton yarn exports, and the regional distribution of these cotton yarn exports in recent years.

443. COTTON CULTIVATION IN ITALIAN SOMALILAND. (*Boll. Cotoniera*, 31, **6**, 1936. From *Summ. of Curr. Lit.*, xvii., **3**, 1937, p. 56.) A production of about 6,000 q. li. (unit apparently about 100 lb.) of seed cotton is reported for the season 1934-35. The classification of the cotton from the ginnery of Vittorio d'Africa is given. The production was 1,803 q. li. of fibre, representing a yield of about 0·63 q. li. of fibre per hectare. The season was not a particularly good one and the average quality of the cotton was lower than that of 1933-34. The ginnery worked for a period of 32½ days. The equipment comprises 44 Platt roller gins and is capable of an output of 69 q. li. of fibre per day of ten hours.

444. JAPANESE COTTON INDUSTRY: DEVELOPMENT AND TRADE WITH AMERICA. By J. W. Proctor. (*Text. World*, **86**, 1936, p. 2079. From *J. Text. Inst.*, xxviii., **1**, 1937, A54.) Since 1925 Japan has doubled her cotton spindles to a total of 10,500,000. The Japanese can purchase American cotton, pay for it in depreciated yen, spin it into yarn, weave it into cloth, bleach it, pay a 25-30 per cent. duty, and sell it in American markets at 20-25 per cent. less than the production cost of a comparable domestic product. Details of increases in exports of Japanese cotton goods to America and the Philippines in recent years are given, and attempts made by the American Government to limit imports by agreements and tariffs are discussed. Japanese imports of raw cotton from America have declined from 2,248,997 bales in 1932 to 1,514,797 bales in 1935. The increase in efficiency in the Japanese cotton industry in recent years is pointed out, and wage rates in the Japanese and American industries are compared.

445. JAPANESE COTTON AND RAYON INDUSTRIES: COMPETITIVE POWER. By P. Ruprecht. (*Leipzig Wochenschr. Text. Ind.*, **51**, 1936, pp. 597 and 609. From *J. Text. Inst.*, xxviii., **2**, 1937, A109.) A general review, with statistics of the influence of Japan on the European cotton and rayon industries.

446. JAPAN'S PIECE-GOODS EXPORTS IN 1936. (*Text. Wkly.*, **19**, 1937, p. 435.) Japan retained her position as the world's leading exporter of cotton piece-goods, but the figures show a decline for the first time since 1931 by about 15,000,000 sq. yards. Owing to the restrictions in the largest markets, which are not compensated by exports to new markets, it does not appear that Japanese exports will continue in the immediate future the rapid expansion of 1931-35.

447. Peru: The Cotton Industry. (*S. Amer. Jour.*, 20/3/37, p. 312.) A brief account of the cotton industry. Peru is the third largest cotton producer in Latin-America, cotton ranking as the second most important crop in the country. Production has about doubled in the last ten or twelve years, and in 1936 was the highest on record, according to estimates of the Customs authorities, while the exports, both in quantity and value, also constituted a record. An average yield of 388 lb. per acre has been obtained in recent years. The bulk of the crop is exported chiefly to Great Britain, Germany, and Japan.

448. Memoria de la Junta Directiva de la Sociedad Nacional Agraria, 1934-35. (Pubd. Lima, 1936.) *Cotton Industry.*—The maintenance of prices has enabled the cultivators to strengthen their financial position. It is considered, however, that the industry must be prepared for a period of less prosperity, by economical cultivation, maintenance of quality, etc. The crop of 1934-35 was 1,624,160 quintals of 46 kilos, compared with 1,234,000 quintals in the previous season.

449. Sea Island Cotton in Puerto Rico and its Relation to Production in the Continental United States. By W. H. Jenkins. (*Agr. Notes Porto Rico Agr. Exp. Sta., U.S. Dpt. of Agr.*, **71,** 1936. From *Pl. Bre. Absts.*, vii., **2,** 1937, p. 211.) Attempts are being made to re-establish the Sea Island cotton industry in Puerto Rico. The Insular Department of Agriculture has selected two uniform, high-quality strains, one having a staple length of 1¾-1⅞ inches and a lint percentage of 29, the other a staple of 2⅛ inches or longer and a lint percentage of 26. Further possibilities in breeding are mentioned. The development of an early, quick-fruiting type with a determinate habit of growth would be of assistance in the control of pink bollworm.

It is also suggested that Puerto Rico might co-operate with the United States in the hybridization of long-staple strains of Sea Island and Upland cottons, with the object of developing a type resistant to the boll weevil with the fibre characteristics of Sea Island cotton. This work might be accelerated by growing a crop during the off-season in Puerto Rico and sending the seed to the United States. The Sea Island-Upland type, if developed, might be of use both to the U.S.A. and to Puerto Rico.

450. Cotton Cultivation in U.S.S.R. (*Int. Cott. Bull.*, xv., **68,** 1937, p. 207.) Cotton cultivation has extended north of the cotton belt to regions such as Northern Caucasus, Azov-Black Sea area, the Crimea, Volga territory, and the Ukraine. The new cotton areas are plentifully equipped with tractors and the necessary agricultural machinery. The total area under cotton in the U.S.S.R. is estimated at 4,793,450 acres. In 1937 over 2,000,000 acres will be planted with a high-quality American Upland variety.

SOILS AND MANURES.

451. Imperial Bureau of Soil Science. (*Rpt. for* 1936-37.) The number of papers abstracted and indexed continues to increase, and is now nearing 4,000. The demand for the "Bibliography of Soil Science" has justified the preparation of a second volume, on which work is in progress. It is hoped to issue this volume, covering the period 1934-37, early in 1938.

452. Pedology. By J. S. Joffe. (Rutgers Univ. Press, New Brunswick, N.J., 1936. From *Exp. Sta. Rec.*, 76, **3,** 1937, p. 302.) A treatise on soils and their development. Much of the scattered work of Russian pedologists, largely unavailable because of the language difficulty, is brought together and presented in an organized form in this book, and related to the work of Western Europe and of the United States.

453. SOILS AND FERTILIZERS. By E. M. Crowther. (Reprinted from *Rpts. of the Progress of App. Chem.*, xxi., 1936.) A useful review of the work of the year 1936 in connection with soil science, given under the following headings: Soil Surveys and Land Classification; Pedology in U.S.S.R.; The Colloids of the Great Soil Groups; Soil Structure and Cultivation; Water Movement and Drainage; Ionic Exchange and Metastructure; Oxidation-Reduction Potentials of Soils; Forest Soils; Hormones and Vitamins; Plant Nutrition; The Production and Use of Fertilizers.

454. SOIL PROBLEMS OF THE ANGLO-EGYPTIAN SUDAN. By H. Greene. (*Emp. J. of Exp. Agr.*, v., **17**, 1937, p. 1.) About 400,000 sq. miles may eventually become available for agricultural development in the southern Sudan, and it is important to study the soil problems as thoroughly as possible in advance. Long-period observation is needed to determine the effects (*a*) of seasonal variation in climate, and (*b*) of cultivation on the moisture-content, nitrogen status, and other properties of the soil. Such changes in the soil with time may be described as soil rhythm, just as changes with depth are described as soil profile. Owing to the lack of traditional knowledge of tropical soils, the study of soil rhythm is of great importance. In the Sudan Gezira no cumulative deterioration of the soil has been detected as a consequence of irrigation, and investigations are accordingly directed to making the best use of the soil in its present condition and to improving it. A start is being made with a direct study of the soil in the southern Sudan, where about 30,000 square miles of country await development. Another task to be attempted as soon as possible is the control of soil erosion along the fringe of the rain-belt. At present information is lacking on this subject, which may prove to be of urgent importance. A more distant pedological objective is the reclamation of the Sudd region of the White Nile.

455. SOME METHODS OF SOIL MANAGEMENT. By D. V. Bal. (*Agr. and Livestock in India*, vii., **1**, January, 1937, p. 1.) A popular article for agriculturists dealing with the general requirements of crops; importance of organic matter in the soil; artificial fertilizers; regulation of soil moisture. Material known as "gutterfly," which is available in large quantities from cotton spinning and weaving mills, has been found to be very valuable as organic manure. Gutterfly consists of the residue obtained when cotton bales are opened and passed through the blower. It usually contains about 80-85 per cent. of organic matter and about 1 per cent. nitrogen. This can be applied during the summer by spreading it on the land and leaving it to get thoroughly moistened by the rain, thereafter turning under as opportunity offers. The Nagpur Agricultural College Farm commenced using gutterfly as a manure many years ago, and experience has shown that, with adequate moisture, it is completely decomposed in about two to four weeks after burying in the soil. Addition of gutterfly has resulted in marked improvement in the condition of the soil and in crop yields.

456. SOIL SAMPLERS. By T. S. Coile. (*Soil Sci.*, 42, **2**, 1936, p. 139. From *Exp. Sta. Rec.*, 76, **2**, 1937, p. 158.) Two types of soil sampling cylinder are described, and their constructional detail is clearly indicated in fully dimensioned drawings. The instrument used for obtaining samples of undisturbed soil for the determination of volume weight, air space, and water-holding capacity "consists of a cutting cylinder made of 5-inch high-pressure steel pipe machined down to the specifications indicated on the diagram, and an inner cylinder made of 5-inch seamless brass tubing. The brass inner cylinder is held in place by a ring and pin while the unit is being driven into the soil with a sledge hammer. A countersunk steel plate or a block of wood placed on the cylinder prevents it from being battered by the hammer. The cutting edge should be case-hardened. Constructed as indicated, the soil cylinder has a volume of 600 c.c., a depth of slightly less than 2 inches, and an inside diameter of just under 5 inches. Lids pressed from 10 oz. copper are used on the brass cylinders for transporting samples from the field to the laboratory. Squares of copper window screen, 16-mesh, have been used effectively over one end of the cylinders while the samples are being saturated with water, and later drained, for the determination of air space and water-holding capacity.

In the case of the cutting cylinder devised for taking samples of undisturbed soil for making determinations of the permanent wilting percentage, " cardboard icecream containers of 1-pt. capacity are placed in an inverted position in the cutting cylinder before it is driven into the soil. The bottom of the container is cut off in the greenhouse, and seeds of the plant to be used for determination of the wilting percentage are planted. The surface is not sealed until the plants have become well established and the moisture content of the soil has been reduced to near the wilting percentage." The author states that ordinary technical paraffin, of a melting point about 54° C., is satisfactory for sealing, and that " if the temperature of the paraffin is not over 60° when it is applied it will solidify as soon as it contacts the moist soil and will not injure the plants."

457. Soil Conservation. By D. Aylen and R. Hamilton Roberts. (*Rhod. Agr. J.*, xxiv., Nos., 2-3, 1937, pp. 90 and 173.) A detailed paper well furnished with diagrams and illustrations. Chapter I. deals with the evils of soil erosion, and the progress made in methods of control in Southern Rhodesia. Chapter II. is concerned with veld and gully erosion; Chapter III. with erosion on cultivated lands; Chapter IV. with construction and maintenance of ridges, etc.

458. Soil Erosion. By W. C. Lester-Smith. (*Trop. Agr.*, February, 1937, p. 92.) A useful and very readable article with good illustrations, dealing with the evils of soil erosion, and describing a number of systems of control, such as by drains, silt pits, contour platforms, grass borders, etc. The value of green manuring is stressed, as leading to the formation of humus which increases the water-retaining capacity of the soil.

459. The Restoration and Maintenance of Fertility. By Sir Albert Howard. (*J. of Farmers' Club*, Pt. I., February, 1937.) Dealing first with the Indore process itself, the author goes on to describe the improvement that can be effected in green manuring by manuring the weeds, leys and pastures with compost or farmyard manure just before ploughing in, and allowing sufficient time for decay and the incorporation of the humus into the soil before the next crop is sown.

460. The Problem of Wind-Eroded Lands. By J. P. J. van Vuren. (*Farmg. in S. Afr.*, March, 1937, p. 108.) Deals with the causes and results of wind erosion, preventive measures, and the rehabilitation of wind-eroded lands.

461. A Study of Ammonia and Nitrate Nitrogen for Cotton. III. and IV. By K. T. Holley and T. G. Dulin. (*Ga. Exp. Sta. Bull.* 197, January, 1937.) III. *Influence of the Nitrogen Concentration in the Nutrient Medium.*—Cotton plants grown in nutrient solutions containing high and low concentrations of nitrate nitrogen made better vegetative growth and produced slightly more bolls than those grown in solutions containing high and low concentrations of ammonia nitrogen. The ammonium salt solution plants had a tendency to better fruiting in the early stages. The high concentration nitrogen solutions contained six times as much N as the low concentration media initially, but under the influence of absorption by the plants this ratio increased to 10 : 12 in the later growth stages. These differences in concentration had no appreciable effect on sap nitrogen or on the total nitrogen percentage in the tissues of the nitrate plants in the early growth stages nor on the total N of the seed at the end of the growth period. In the case of ammonium salt solutions the higher concentration of nitrogen in the medium produced plants with a higher sap nitrogen content and a higher total N content in the early growth stages and much higher content of nitrogen in the seed. Under these growing conditions the higher N content of the high ammonia nitrogen plant saps was most evident in the amide or asparagin N fraction of the saps. The concentration of nitrogen offered in either case had no pronounced effect on the ash, calcium, or magnesium content of the seed, or on the soil content of the seed or on the iodine number of the oil. It is concluded that the accumulation of nitrates within the tissues is one of the principal factors governing the absorption response of the plants to variations in the concentration of nitrates in the medium, and that the increased absorption of nitrogen from the higher concentration ammonium salt solutions is in part due to the fact that there is no appreciable accumulation of the ammonium ion in the tissues.

IV. *Influence of Boron Concentration.*—Although the addition of 10 p.p.m. boron, added as H_3BO_3, showed a decided improvement in the growth of cotton plants in nitrate nutrient solutions in spring cultures which were not constantly renewed, the same addition had no appreciable effect on the growth and fruiting of cotton in summer cultures supplied with ammonium salts and nitrates as sources of nitrogen when compared with a much lower level of added boron. The higher added boron had no appreciable effect on the fruiting tendency or on boll production in the case of either source of nitrogen. The higher level of added boron did not increase the boron content of the leaves in anything like the proportion of the amounts added. There is no evidence from these results that there is an interrelation between boron and calcium or magnesium utilization by the plant. The fruiting tendency of the nitrate plants was nearer that of the ammonia plants at both the high and low added boron levels in these plants, and it is concluded that some factor other than added boron was responsible for this variation from the fruiting tendencies previously reported. In the early growth stages 10 p.p.m. added boron had no appreciable effect on the nitrogen fractions of the saps of plants grown on either form of nitrogen as compared with those grown on a lower level of boron. It is concluded from H-ion concentration measurements on the expressed saps of plants of these and previous cultures that acid-base balance is maintained at about the same level in the saps of plants grown on either ammonium salts or nitrates in spite of the fact that nitrate plants have a more basic ash. Further evidence is offered to show that under the conditions of these experiments cotton plants supplied with ammonium salts tend towards a slightly lower water content than those supplied with nitrates. However, there is no evidence to show that the source of nitrogen has a direct influence on the water economy of the plant.

[*Cf.* Abstrs. **553,** Vol. IX. and **432,** Vol. XII. of this Review.]

462. MOLASSES, NITROGEN FIXATION AND LAND RECLAMATION. (*Nature,* 11/4/36, p. 629. From *Agr. and Livestock in India,* vii., **1,** January, 1937, p. 104.) In his Presidential address to the United Provinces Academy of Sciences, India, on December 19, 1935, Professor N. R. Dhar gave a general account of the work carried out by himself and his collaborators on nitrogen transformations in soil. Professor Dhar leads the school of thought which believes that nitrification in soils and nitrogen fixation from the atmosphere are, especially in the tropics, photochemical at least as much as bacterial actions. He has produced strong evidence in support of his theories, and the question appears now to have reached the stage at which the protagonists of bacterial and photochemical nitrification respectively are unwilling to admit any evidence which might shatter their beliefs. Meanwhile, other soil workers will be wise to keep an open mind on the matter, for the philosophical implications of recognizing that light plays a part in soils analogous to photosynthesis in the vegetable kingdom are at least as important as the practical possibilities of utilizing that knowledge for the enrichment of the soil. Given sufficient facts, their practical application does not necessarily depend on their correct interpretation. The practical facts of Professor Dhar's researches are that Indian soils are generally deficient in nitrogen, that more than half a million tons of molasses from the sugar industry are annually wasted in India, and that the application of molasses to the soil can double and may treble the soil nitrogen content, with a consequent large increase in crop yield.

Molasses contains about 70 per cent. of carbohydrates and small quantities of nitrogen, phosphorus, potash, etc., these quantities, however, being much too small to account for the observed manurial effect. According to Professor Dhar, the energy set free in the oxidation of the sugars in molasses is utilized, either bacterially or photochemically, in promoting nitrogen fixation and nitrification. Whatever the nature of the process, Dhar has produced indisputable evidence of increases in available soil nitrogen and crop yields following the application of molasses. Under temperate conditions, the converse result would be expected, as it is well known that the addition of carbohydrate-rich material to soil tends to reduce the amount of nitrogen available to plants, the nitrogen becoming fixed as microbial protoplasm or as humus. An essential difference, however, between temperate and tropical soil requirements is that, whereas in temperate regions the limiting factor to crop growth is often the slowness, in the tropics it is the rapidity with which soil nitrogen is made available to plants, soluble nitrates being formed and leached from the soil before they can be absorbed by the crop. The general effect of molasses on the soil should be the same everywhere, but only in the tropics will its "braking" effect on the mobilization of soil nitrogen be a positive advantage to the cultivator, and only in the tropics will its stimulation of atmospheric nitrogen fixation, whether bacterial or photochemical, be appreciable, since temperate regions lack the heat necessary for bacterial and the light for photochemical stimulation.

For these reasons, the potentialities of carbohydrate manuring—of which molasses manuring is an example—have perhaps been overlooked by agriculturists. If Professor Dhar can substantiate his claims, he may effect a revolution in agriculture in India, where the supply of the ordinary organic manures is far below the demand. Professor Dhar suggests that a most valuable use can be made of molasses in reclaiming alkaline land. The acids produced in the decomposition of molasses neutralize the alkalies, and at the same time, and contrary to experience when land is reclaimed with gypsum or sulphur, soil nitrogen is increased. A period of about four years is usually necessary to reclaim alkali land with gypsum, whereas with molasses applied at a rate of 30 to 40 tons per acre, good crops can be grown within six months. It is not stated whether such reclamations have been found permanent—in view of the oxidizability of the neutralizing acids this is open to doubt—but the method obviously merits further study. There are four million acres of infertile alkali land in India, and irrigation practices are increasing the area. The economic reclamation of these lands is one of the country's greatest agricultural problems, to the solution of which Professor Dhar's work is pointing the way.

CULTIVATION, IRRIGATION, GINNING, ETC.

463. THE DESIGN OF EXPERIMENTS. By R. A. Fisher. (Pubd. by Oliver and Boyd, Ltd., Edinburgh, 1937. Price 12s. 6d. net.) This is the second edition of this important work and differs little from the first, published a year earlier. Apart from numerical corrections the principal changes have been the fuller treatment of completely orthogonalized squares in Section 35, and the addition of examples in Section 47. I., representing some of the newly-developed combinatorial arrangements, which are attracting considerable interest. The numbering of Sections has not been changed.

[*Cf.* Abstr. **97**, Vol. XIII. of this Review.]

464. SOME PRINCIPLES OF STATISTICS AND THEIR APPLICATION TO AGRICULTURAL EXPERIMENTS. By F. E. Allan. (*J. Aust. Inst. Agr. Sci.*, ii., 1936, pp. 17, 67, 154. From *Pl. Bre. Absts.*, vi., 1936, p. 337; and vii., 1937, pp. 129 and 269.) A series of four articles dealing with the elementary principles of statistical method in its application to biological research. Pt. I. deals with the notions of probability and frequency distributions; Pt. II. with the normal distribution, "Student's" *t* test and Fisher's analysis of variance; Pt. III. with the fitting of regression lines and calculation of regression and correlation coefficients; Pt. IV. with the goodness of fit.

465. STATISTICAL METHODS AND THEIR APPLICATION TO AGRONOMY—A BIBLIOGRAPHY. Compiled by K. K. Guha Roy and P. C. Mahalanobis. (*Misc. Bull. No.* 9, Imp. Coun. of Agr. Res., New Delhi, 1936.) This list of 1,597 names is confined to references on statistical methods and their application mainly to agronomy. It does not claim to be exhaustive, and merely records such references as are found in the Pusa Library, with 312 additions made from the Statistical Laboratory, Calcutta.

466. SUGGESTION OF A NEW FORMULA—FOR THE DEVIATION OF THE MEAN METHOD. By Y. K. Yang. (In Chinese with English translation.) (*Hopei Jour. of Agr. and Forestry*, vol. i., 1935, Hopei, China.)

467. AN ABBREVIATED METHOD AND A SUGGESTED CHEAP MECHANICAL DEVICE FOR CALCULATING THE STANDARD DEVIATIONS OF OBSERVATIONS. By J. L. Spencer-Smith and H. A. C. Todd. (*J. Text. Inst.*, xxviii., 2, 1937, T21.) A rapid graphical method of calculating the standard deviation of a set of observations by means of Galton's "ogive" curve is described.

468. RECENT ADVANCES IN FUMIGATION AND THE NEEDS OF FUMIGATION PRACTICE. By J. W. Munro. (*Agr. and Livestock in India*, vii., 2, 1937, p. 192.) The complexity of the fumigation process is shown, and the general principles of application are discussed, particularly with reference to the beneficial effect of heat. An account is given of the action of "auxiliary" fumigants, and it is pointed out that the effect of vacuum fumigation may be less important than has been supposed. The author outlines the position of the study of residues left after fumigation from the standpoint of the distribution and penetration of gases during fumigation, and it is pointed out that special measures may be required to secure even moderately uniform concentrations of the gas. The importance of methods of sampling in this connection is made clear, and the attention of the chemical engineer is drawn to the need for securing rapid and even distribution of the fumigant, for the study of various methods of packing and piling goods for fumigation, and for improvements in means for ensuring complete removal of residual fumigant.

469. COTTON SEED DELINTING WITH SULPHURIC ACID: EFFECTS ON GERMINATION. By B. G. Christidis. (*J. Agr. Sci.*, **26**, 1936, p. 648. From *Summ. of Curr. Lit.*, xvii., 3, 1937, p. 57.) The experimental evidence discussed in this paper does not appear to justify the use of seed treated with sulphuric acid, since no practical advantage attached to it could be definitely established.

470. A PORTABLE CHAMBER FOR TREATING PLANTS WITH HEAT. By R. A. Brink. (*J. Amer. Soc. Agr.*, **28**, 1936, p. 1021. From *Pl. Bre. Absts.*, vii., **3**, 1937, p. 290.) A description of a bottle with an electrically heated water jacket, used for inducing polyploidy.

471. CHEMICAL DUST TREATMENT OF COTTON SEED FOR PLANTING PURPOSES. By H. P. Smith *et al.* (*Bull. No.* 531, Texas Agr. Exp. Sta., 1936.) Studies were commenced in 1930 by the Texas Agricultural Experiment Station to determine the effect on stands and yields of cotton of different methods of delinting and treating the seed. In these studies tests were made to determine the influence of date and rate of planting and the best depth of listed furrow in which to plant cotton. The field work in the experiments was carried out at the U.S. Cotton Breeding Field Station at Greenville, at College Station, Angleton, Lubbock, and Temple, and in the Brazos River Bottoms near College Station.

Treating fuzzy cotton seed with Ceresan increased the number of seedlings that emerged from 11 to 65 per cent., and the yields from 4 to 25 per cent., when the cotton seed was planted at the optimum rates and dates. In the early planting of fuzzy cotton seed treated with Ceresan for a three-year period at Lubbock, a smaller number of seedlings emerged and a smaller percentage of seed germinated, with no significant difference in yields. Ceresan treatment of mechanically delinted cotton seed planted at the optimum rate and date gave a larger number of seedlings emerging at College Station, Temple, Lubbock, and in the Brazos River Bottoms, than did untreated seed. At Greenville, seedlings from cotton seed treated with Ceresan and Bayer Dust 502 and delinted with hydrochloric acid gas and sulphuric acid had a smaller number of plants infected with angular leaf spot disease in the early seedling stage than did those from untreated seed. Ceresan-treated seed planted at Temple had a smaller percentage of seedlings affected with angular leaf spot. Bayer Dust treatment of fuzzy seed planted at the optimum date and depth of furrow gave fewer seedlings but slightly higher yields than untreated seed. Mechanically delinted seed treated with Bayer dust gave more seedlings but slightly lower yields than untreated seed. Copper carbonate treatment of both fuzzy and mechanically delinted seed did not prove beneficial. When cotton was planted at Lubbock on April 25, May 5, May 15, and May 25, the total number of plants obtained generally increased with the lateness of planting. There was a general tendency for the stand of plants to increase as the rate of planting increased. Cotton seed planted in a 4-inch furrow at Lubbock gave a larger number of seedlings than either the surface planting or the 7-inch listed furrow. At Lubbock, cotton thinned to a 12-inch spacing gave higher yields than unthinned cotton.

472. AGRICULTURAL IMPLEMENTS. By C. R. Karunaratne. (*Trop. Agriculturist*, lxxxvii., 1936, **5**, p. 283, and subsequent numbers.) A series of articles describing a number of simple implements used in India and Ceylon which are suitable for general adoption by the village agriculturist. Descriptions, with diagrams, are given of the Indian seed drill, the blade harrow, the tooth cultivator, etc.

473. CULTIVATION MACHINERY. We have received from Messrs. Ransomes, Sims, and Jefferies, Ltd., a copy of their Mechanical Cultivation Catalogue No. 12500E, containing good illustrations and descriptions of the share and disc ploughs, harrows, cultivators, and other implements for use with tractors, and an even wider range for animal draught that are manufactured by them. The photographs depicting the machines at work in different countries should prove of particular interest to oversea agriculturists, and should be helpful in solving problems resulting from local conditions.

474. EFFECTS OF DELAYED HARVESTING BY PICKING AND SNAPPING ON SIX VARIETIES OF COTTON. By J. F. O'Kelly and W. W. Hull. (*Miss. Sta. Bull.* 316, 1936. From *Exp. Sta. Rec.*, 76, 3, 1937, p. 325.) In harvesting studies with six varieties of cotton ranging in boll size from very small to medium big and in plant character from dwarf with light foliage to tall and heavy foliage, lint cotton could be obtained early in the season 2·11 times as fast by snapping as by picking, and the ratio rose to 3·91 by the last harvest.

475. EL SECADO MECANICO DEL ALGODON. By T. Boza and J. Paez. (*Circ. No.* 34. Min. de Fomento, Est. Exp. Agr. de la Molina, Lima, Peru, 1936.) A general account, in Spanish, of the mechanical drying of cotton.

476. L'EGRENAGE DU COTON. By M. Pilette. (*Bull. Trim. du Com. Cotonn. Congolaise*, Nos. 1-4, 1936-37.) The first paper deals with cotton ginning experiments in America. In 1930 Congress voted $100,000 with which an elaborate station was set up at Stoneville, Mississippi, with a view to determining the effects of drying and other factors upon the cotton seed. In other laboratories work was carried on upon detailed examination of the seed and fibre, upon spinning, etc. Neps were the object of special study. The general object of the work was to localize the evils and then to study and recommend the remedies.

The second paper deals with saw gins. Over 99 per cent. of the American crop is treated by saw gins. The various developments through which the saw has passed are sketched and discussed. Recently Bennett of the Stoneville laboratory has published the results of his researches, showing that the form of the teeth, their inclination, etc., all affect the result. Methods of repairing the saws are mentioned, and stress is laid upon the necessity of repair by skilled men. The speed producing the best results is not yet settled, varying with the type of gin, but the speed recommended by the makers should be rigorously observed.

The third paper is concerned with the saw gin condenser, the action of which is explained by means of diagrams; proper adjustment of the cage, speed, etc., will prove effective in separating dust from the cotton.

The fourth paper is concerned with the risks of fires in ginneries. These are a constant source of danger, and may be due to foreign matter in the cotton, static electricity generated in the gin, badly kept saws, and the use of wet cotton. Precautions against the risk of fire are discussed.

477. GIN DAMAGE OF COTTON IN RELATION TO RAINFALL. By G. R. Smith. (*N. Carolina Sta. Bull.* 306, 1936. From *Exp. Sta. Rec.*, 76, 3, 1937, p. 325.) An investigation involving many thousands of cotton samples from a number of gins in the principal cotton-growing districts of North Carolina ginned during the months of August to December, inclusive, showed that the percentage of gin-damaged cotton is highest at the beginning of the season, decreases rapidly each month until November, and remains about the same through December. A closer relationship appeared to exist between rainfall and gin-damaged cotton during the early part of the harvest season.

COTTONSEED AND OIL

478. CHEMISTRY AND TECHNOLOGY OF COTTONSEED-OIL PRODUCTION. (*Union Inst. Sci. Res. on Fats*, Leningrad, 1936.) A collection of articles in Russian, with English summaries. The English titles of the papers are given as follows: "The Principal Problems of Chemistry, Physico-Chemistry and Technology of Cottonseed Oil Production" (A. Goldowskij); "Anatomo-Microchemical Investigations of the Seed of Two Transcaucasian Types of Cotton" (M. Gurewitch); "The Cottonseed Proteins and their Thermic Denaturation in the Production" (A. Goldowskij and S. Moldawskaja); "The Carbohydrates of the

Cotton Seed" (E. Mirer); "The Behaviour of Gossypol in the Cottonseed Oil Production" (A. Goldowskij and M. Podolskaja); "The Influence of Gossypol on the Colour of Cottonseed Oil" (M. Podolskaja); "The Factors determining the Colour of Cottonseed Cake" (A. Goldowskij *et al.*); "The Red Gossypol" (M. Podolskaja); "The Rupture of the Cell Walls at the Cooking of Cotton, Sunflower and Linseed Meal" (A. Goldowskij *et al.*); "The State of the Oil in the Protoplasm of Oil-Seed and the Dyeing of Oil in the Cell" (N. Neumann).

479. THE ISOLATION FROM COTTONSEED OIL OF AN ALCOHOL RESEMBLING ALPHA TOCOPHEROL FROM WHEAT-GERM OIL. By O. H. and G. A. Emerson and H. M. Evans. (*Sci.*, 83, No. 2157, 1936, p. 421. From *Exp. Sta. Rec.*, 76, **2**, 1937, p. 148.) A brief note from the University of California reports the isolation from cottonseed-oil of four allophanates, of which one, melting at from 158° to 160° C., appeared identical with the allophanate prepared from an alcohol obtained by the authors from wheat-germ oil and designated "*a*-tocopherol." The two compounds have the same melting-point, there is no depression in mixed melting-points, both compounds exhibit a maximum absorption in the ultra-violet between 2,900 and 3,000 a.u., and the alcohols regenerated from them show similar biological activity. The substance designated *a*-tocopherol was found to have the properties of vitamin E.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL

480. THE BIOLOGICAL CONTROL OF INSECTS. By H. L Sweetman. (Comstock Pubg. Co., Inc., Ithaca, N.Y., 1936, $3.75. From *Pl. Bre. Absts.*, vii., **3**, 1937, p. 346.) A text-book for both students and research workers in the field. The various forms of life considered of value in the biological control of pests are described. These range from bacteria to vertebrates, but the insects form the largest and most important group.

481. THE BIOLOGY OF THE THYSANOPTERA, WITH REFERENCE TO THE COTTON PLANT. VIII. THE RELATION BETWEEN VARIATIONS IN TEMPERATURE AND THE LIFE CYCLE. By E. I. MacGill. (Reprinted from *Ann. App. Biol.*, xxiv., **1**, 1937, p. 95.) The exposure of larvæ of *Thrips tabaci* to temperatures of 38°, 31°, 8° and $-4°$ C. for periods varying from 1 to 96 hours has a marked effect on the survival of the insects. At 100 per cent. relative humidity exposure to 38° and 31° C. gives a higher rate of mortality than exposure to 8 and $-4°$ C.; at 82 per cent. relative humidity 38° and $-4°$ C. are the least favourable temperatures, and at 75 per cent. relative humidity $-4°$ C. is the most unsuitable for the survival of the insects. In some conditions more larvæ survive after a long exposure than after a shorter one, which suggests that at certain points in their life-cycle the insects are particularly sensitive to changes in their environmental conditions. From these experiments it does not appear that relative humidity has a marked effect on the length of the life cycle. Exposure to low temperatures has a more constant effect on the length of the larval stage than exposure to high ones; exposure to $-4°$ C. retards development for a longer time than the duration of the exposure, and exposure at 8° C. for a shorter time. The length of the life cycle varies with the absolute humidity of the atmosphere and at vapour pressures below 15 mm. the conditions have a retarding influence on development, while those between 15 and 25 mm. accelerate development.

[*Cf.* Abstrs. **108**, Vol. V., **618**, Vol. VI., **360**, Vol. VII., **279**, Vol. VIII., **194**, Vol. IX. of this Review.]

482. INJURIOUS INSECTS OF CYPRUS. By H. M. Morris. (*Bull. No.* 4, Ent. Ser. Dpt. of Agr., February, 1937.) The records on which this list is based have mostly been obtained during the past fourteen years, there being very few records dating from before that period. The chief pests attacking cotton in Cyprus are: *Calliptamus italicus*, L., *Tettigonia viridissima*, L., *Decticus albifrons*, Serv., *Aphis gossypii*, Glov., *Platyedra gossypiella*, Saund., *Earias insulana*, Bois., *Sibinia planiuscula*, Desbr., *Gitona beckeri*, Duda.

The most serious injury is caused by *Platyedra gossypiella*, *Earias insulana*, and *Aphis gossypii*.

483. NYASALAND: REPORT OF THE ENTOMOLOGIST, 1935. By C. Smee. (*Rpt. of Dpt. of Agr., Nyasaland*, 1935.) Climatic conditions during the breeding season were unfavourable to the development of *Nomadacris septemfasciata*. In some districts no eggs hatched, in others no flying swarms developed from the hoppers. The destruction due to *Empusa grylli* was considerably greater than had been previously experienced; heavy mortality was recorded among even first instar hoppers. Locusts caused most injury in the Lower Shire district, where hopper bands attacked cotton and food crops.

484. TANGANYIKA: COTTON PESTS IN 1935. By A. H. Ritchie. (*Ann. Rpt. of Dpt. of Agr.*, 1935, p. 102.) Marked injury was caused to cotton by *Helopeltis*, and a recrudescence of *Apion xanthostylum* indicated the need for tightening up "dead season" sanitation measures. The wild food plant of *Apion* is not yet known, but that of pink bollworm in Tanganyika is *Hibiscus esculentus*. Parasites of pink bollworm include *Microbracon kirkpatricki*, *Chelonus curvimaculatus*, and *Brachymeria olethrius*. The Apion weevil is parasitized by *Entedon* sp., and the cotton-leaf roller, *Sylepta derogata*, by *Microbracon recessus*, *Apanteles sagax* and *A. syleptæ*. In the Western Province an undescribed *Platyedra* was reared from kidney cotton, and *Plemyristis œnochares*, Meyr., was also reared; the latter attacks the seeds of cotton, coffee and other plants.

485. COTTON PEST INVESTIGATIONS IN THE WINDWARD AND LEEWARD ISLANDS. By F. A. Squire. (*Half-yrly. Rpt., Sept.*, 1936 *to Feby.*, 1937.) Discusses the history, distribution, bionomics, nature of injury, and alternative host plants of the pink bollworm and cotton stainer. As a first step to more effective control of cotton pests the author urges a more thorough cleaning up prior to the close season, and co-operation between growers and the agricultural departments is essential for this to be effectively done. The danger of keeping cotton seed and seed cotton in unauthorized places during and after the close season is also emphasized, and special measures will have to be taken to eliminate this source of infection.

486. SOME RESULTS OF A STUDY OF INSECTS BY MEANS OF LIGHT TRAPS IN CENTRAL ASIA. By P. P. Bogush. (*Bull. Ent. Res.*, xxvii., **3**, 1936. From *Rev. App. Ent.*, xxv., Ser. A, **2**, 1937, p. 72.) Light traps have been in use in Turkmenistan since 1930, and up to 150,000 insects have been caught in a single night in a trap equipped with a 500-watt light. An outline is given of the ways in which data of various kinds were obtained by means of the traps.

487. EL ARREBIATADO Y OTROS INSECTOS DANINAS AL ALGODONERO EN LOS VALLES DEL NORTE DEL PERU. By J. E. Wille *et al.* (*Bol.* 9, *Min. de Fomento. Est. Exp. Agr. de la Molina, Lima, Peru,* 1936.) A study, in Spanish, of various cotton pests, including *Dysdercus ruficollis*, *Gasterocercodes gossypii*, *Anthonomus vestitus*, aphis, thrips, and red spider.

488. BOLL WEEVIL ACTIVITY DURING NORMAL HIBERNATION PERIOD AT TALLULAH, LA. By R. C. Gaines. (*J. Econ. Ent.*, December, 1936, p. 1096.) These observations indicated that a surprisingly large number of boll weevils became active during the normal period of hibernation. Under artificial cage conditions 1 per cent. of the total boll weevil activity occurred when maximum temperatures ranged from 36° to 45° F. The screen records indicated that maximum temperatures of 62° F. or higher are necessary before actual flight takes place.

489. Field Movement of Boll Weevils in Relation to Initial Infestation and Rainfall. By G. L. Smith and M. T. Young. (*J. Econ. Ent.*, December, 1936, p. 1063.) Comparison of boll weevils in movement, as recorded on screens at Tallulah, La., 1933-35, shows a positive correlation between number of weevils taken and total rainfall over the corresponding periods. It also indicates a positive correlation between the number of weevils taken and number of days with ·3 inch or more of rainfall.

490. Note sur l'Hibernation du Ver Rose au Congo Belge (*Pectinophora Gossypiella* Saund.). By H. J. Bredo. (*Bull. Agr. Congo Belge*, xxvii., **3**, 1936, p. 442. From *Rev. App. Ent.*, xxv., Ser. A, **2**, 1937, p. 103.) In view of the occurrence of pink bollworm in the north-west of the Belgian Congo the possible physiological reasons for the production of long-cycle larvæ are reviewed from the literature. Records of temperature and humidity throughout the year in this area are tabulated, and it is concluded that, if the diapause is due to cold or low humidity, conditions that would induce it do not occur at any time except possibly in the last week of February. A long-cycle larva occurs within the seed in which it has developed, or between two seeds partly hollowed out and stuck together (double seeds). In order to find if this stage occurs, samples of about 11 lb. of seed from each cotton ginnery in the north-west of the Belgian Congo were examined. These samples resulted from the ginning of the second crop. In 717 lb. containing about 3,900,000 seeds, 38 insects were found, of which 9 were larvæ and pupæ of *P. gossypiella*, 22 were other species (some unidentified), and 7 were dead. None of these was found in groups of seeds adhering to one another, and the adhesion of these seeds was probably due to the action of a fungus. It is thought that none of the larvæ of *P. gossypiella* was in the diapause. It is probable that the diapause does not occur, as the food-plant is abundant in the different cotton-growing areas during the period normally occupied by it, and the climatic conditions are favourable for continual reproduction.

491. Some Pink Bollworm Studies in Egypt. By I. Bishara. (*Tech. and Sci. Serv. Bull.* No. 163. Ent. Ser., Min. of Agr., Egypt, 1936.) Pink bollworm has been a major pest of cotton in Egypt for more than twenty years, the average annual losses amounting to over a million kantars of cotton. Infection is carried over from one season to another in (*a*) ratoon or stand-over cotton; (*b*) seed cotton and seed; (*c*) bolls fallen to the ground and subsequently ploughed under winter crops; (*d*) refuse bolls attached to cotton sticks stored for fuel. In a discussion of the relative importance of these sources of infection to the new cotton crop it is shown that cotton sticks supply about 90 per cent. of the moths that are likely to breed on the new cotton crop, the rest being supplied by the larvæ in buried bolls.

492. Control of the Cotton Flea Hopper. (*Texas Agr. Exp. Sta. Circ. No.* 77, 1936. From *Rev. App. Ent.*, xxv., Ser. A, **1**, 1937, p. 38.) Notes are given on the damage caused to cotton in Texas by *Psallus seriatus*, Reut., and on its seasonal history. As a control measure dusting with superfine sulphur is preferred to burning the cotton stalks to destroy the eggs, since the loss of organic matter exceeds the gain by egg-destruction. Strip-cultivation is recommended, and dusting with 12 to 20 lbs. sulphur per acre at weekly intervals for ordinary infestations, beginning as soon as it becomes evident that the plants are not putting on squares normally. Types of dusting apparatus suitable for different areas of crop are indicated.

[*Cf.* Abstrs. **53**, **361**, Vol. IX., **110**, Vol. XI., **621**, **640**, Vol. XIII., and **102**, Vol. XIV. of this Review.]

493. THE COTTON WEB-SPINNER. By W. J. S. Sloan. (*Queensland Agr. J.*, December, 1936, p. 718.) The cotton web-spinner, *Loxostege affinitalis*, Led., was first observed in the Callide Valley five years ago, but caused little injury. In 1935-36, however, quite serious losses were experienced. The life-cycle stages of the pest are illustrated and described, and the probable cause of outbreaks, distribution in cotton and other districts, nature and extent of injury, host plants, natural enemies, and measures of control advocated, are discussed. Clean cultivation, eradication of weeds, and spraying with a solution of 1 lb. arsenate of lead, 1 gallon molasses (or 7 lb. treacle) and 6 gallons water, proved very successful in control.

494. HELOPELTIS BUG. By W. V. Harris. (*E. Afr. Agr. J.*, ii., **5**, March, 1937, p. 387.) A description of *Helopeltis bergrothi*, its life history, host plants, and nature of injury. Control is suggested by dusting with finely powdered pyrethrum.

495. OBSERVATIONS RELATIVES À QUELQUES HÉMIPTÈRES DU COTONNIER. By J. V. Leroy. (*Publ. Inst. Etude Agr. Congo Belge*, Ser. Sci. No. 10, 1936. From *Rev. App. Ent.*, xxv., Ser. A, **3**, 1937, p. 193.) An account is given of experiments to ascertain the relation of certain capsids and the jassid, *Empoasca facialis*, to malformations of the leaves of cotton in the Belgian Congo, together with observations on the biology of some of them. The types of injury are described, with details of that commonly known as frisolée, in which large holes appear in the leaves. Experiments in which three species of capsids associated with this type of injury were fed separately on cotton plants showed that it was produced by nymphs and adults of *Lygus simonyi*, Reut. (*vosseleri*, Popp.), and not by *Derœocoris oculatus*, Reut., or *Sthenarus leucochilus*, Reut. *L. Simonyi* feeds mainly on the young leaves not yet fully expanded, and on the flower buds. The punctures result in the formation of small brownish-black spots of dead tissue that split as the leaf grows, so that increasingly large perforations bordered with brown or black appear. When the flower buds are attacked and perforated at their base, they are shed after 4 or 5 days. The lesions caused by *Helopeltis bergrothi*, Reut. are discussed. Those caused by *Empoasca facialis* are due to it feeding on the lower surface of the cotton leaves, mainly on the veins, with the result that the leaves curl, the edges become reddish and dry up, the buds are shed, and the whole plant is stunted. Attempts to obtain the eggs of *L. simonyi* were unsuccessful. Measurements are given of the later nymphal instars and adults. Natural enemies of the nymphs included an unidentified Hymenopterous parasite and *D. oculatus*. *D. oculatus* was found to be an active predator, feeding on nymphs of *L. simonyi* and on jassids and aphids. The nymphs did not survive on cotton leaves in the absence of these insects. The eggs of *D. oculatus* and *H. bergrothi* were laid in the tender parts of the cotton shoots, and those of *E. facialis* in the veins of the leaves. The durations of the egg and nymphal stages in days, as determined by the rearing of 50 nymphs, were 12-14 and 23 for *D. oculatus*, 6-8 and 8 for *E. facialis*, and 13-17 and about 40 for *H. bergrothi*. About 0·5 per cent. of the nymphs and adults of *H. bergrothi* were destroyed by an unidentified Hymenopterous parasite. Excellent illustrations are included.

[*Cf.* Abstrs. **593**, Vol. XI., **120**, **477**, **653**, Vol. XIII. of this Review.]

496. LOCUSTS. By N. C. Mehta. (*Rpt. Coun. Agr. Res. India*, 1935-36, p. 36. Delhi, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, **12**, 1936, p. 809.) As a result of a study of records of *Patanga succincta*, L., the dates of its outbreaks since 1872 are enumerated. There were two great cycles of multiplication, during 1881-4 and 1901-8, since when the species has been quiescent. It has only one generation a year, and starts to breed after the beginning of the monsoon rains.

497. MEMORIA DE LA COMISION CENTRAL DE INVESTIGACIONES SOBRE LA LANGOSTA CORRESPONDIENTE AL ANO 1934. (Min. Agr., Buenos Aires, Argentina, 1936. From *Rev. App. Ent.*, xxv., Ser. A, **2**, 1937, p. 114.) In continuation of field research organized by the Central Commission of Locust Investigations in Argentina in 1933, three expeditions were sent out in the winter of 1934 to investigate the hibernation areas of *Schistocerca paranensis*, Burm., in the northern provinces. Much information is given in this long abstract of the interesting field work upon the pest described in the reports of the commissions. These reports are accompanied by meteorological maps and tables.

498. UNE EPIDÉMIE CHEZ LES SAUTERELLES MIGRATRICES. ISOLEMENT D'UN BACILLE PATHOGÈNE. ESSAIS DE TRANSMISSION DE LA MALADIE. By G. Bouvier. (*Ann. Inst. Pasteur*, 57, **1**, Paris, 1936. From *Rev. App. Ent.*, xxiv., Ser. A, **10**, 1936, p. 637.) In February, 1934, swarms of *Nomadacris septemfasciata* and *Locusta migratoria migratorioides* were found dying in Belgian Congo. A number of bacilli, which are described, were obtained from dead *Locusta* by means of the usual culture methods. The culture of a bacillus referred to as " H " was very virulent when inoculated into the body cavity of *Nomadacris* hoppers, and the fatal disease caused by it was found to be contagious.

499. SOMMAIRE DES OBSERVATIONS FAITES AU CONGO BELGE ET PROJET DES FUTURES RECHERCHES SUR LES ACRIDIENS MIGRATEURS. By H. J. Bredo. (*Bull. Agr. du Congo Belge*, xxvii., **2**, 1936, p. 298.) An outline is given of (*a*) the organization for reporting locust activities in the Belgian Congo, (*b*) the research work carried out in the north-east of the Colony, and (*c*) the proposed research concerning the centres of multiplication of *Nomadacris septemfasciata*.

500. ÉTAT DES RECHERCHES SUR LES SAUTERELLES MIGRATRICES. By P. Vayssière. (*Rev. Ass. Franc. Sci.*, 64, **3**, 1936, p. 111. From *Rev. App. Ent.*, xxiv., Ser. A, **11**, 1936, p. 679.) A brief account is given of the international organization of anti-locust research, and in particular of the work of the French entomologists in West Africa.

501. SECULAR TRENDS OF LOCUST OUTBREAKS IN THE PHILIPPINES AND THEIR APPARENT RELATION WITH SUNSPOT CYCLES. By L. B. Uichanco. (*Philipp. Agr.*, xxv., **4**, Laguna, 1936, p. 321. From *Rev. App. Ent.*, xxiv., Ser. A, **12**, 1936, p. 810.) The records of the outbreaks of *Locusta migratoria manilensis*, Meyen, in the Philippine Islands, obtained by an exhaustive study of historical documents, are enumerated. They date from 1569, and the average interval between the outbreaks is eleven years. A comparison of these records with sunspot data shows that there is a fairly definite negative correlation between solar activity and locust fluctuations, the outbreaks of the gregarious phase being most widespread in the year when the average sunspot area is 500 millionths or less of the visible solar hemisphere.

502. A POISON BAIT FOR RED LOCUST HOPPERS. (*Rhod. Agr. J.*, xxxiv., **2**, 1937, p. 137.) Successful results have been obtained in South Africa against red locust hoppers with a mixture of arsenite of soda and maize meal. Details are given of the manufacture of the poison bait, and the methods of use against the locust hoppers.

503. THE GREY FIELD MOUSE, *Mastomys coucha*. By W. V. Harris. (*E. Afr. Agr. J.*, ii., **4**, 1937, p. 315.) This animal does a considerable amount of injury to cotton in certain districts of Tanganyika by feeding on the seeds of the ripening bolls, and in some seasons the numbers assume the proportions of a plague. A description is given of a poison bait containing barium carbonate which is stated to be the most satisfactory method of control.

504. LE DYSDERCUS, RAVAGEUR DU COTONNIER. By A. Brixhe. (*Bull. Agr. du Congo Belge*, xxvii., **4**, 1936, p. 625.) In Belgian Congo a double parasitism is exercised. The punctures of the insect prevent the growth of the young shoot and result in serious shedding. They also introduce into the boll various harmful fungi which cause damage from simple staining to complete rot. Methods of control include destruction of host plants, burning of cotton refuse, and hand collection of the insects. It is hoped that ecological study may provide better methods of control.

505. THE TSETSE FLIES OF EAST AFRICA: A FIRST STUDY OF THEIR ECOLOGY, WITH A VIEW TO THEIR CONTROL. By C. F. M. Swynnerton. (*Trans Roy. Ent. Soc. London*, vol. 84, 1936. From *E. Afr. Agr. J.*, March, 1937, p. 340.) The author, who is Director of the Tsetse Research Dept. of Tanganyika Territory, has treated the whole subject in a most comprehensive manner: he views the problem as a Pan-African one, compares the methods employed and the progress achieved throughout the continent, presents in summary form what has been learned of the life-history of the several species of tsetse that must be attacked, and discusses the best means of utilizing the new land that is being won. Careful investigation and experiment over some years have led to the conclusion that direct methods of control, such as are generally employed to combat crop pests, or biological control, have little chance of defeating the tsetse. The problem is peculiar in that the pest cannot be controlled satisfactorily by mere reduction of its numbers; nothing short of complete local extinction secures its territory for permanent human settlement. For these reasons the attack that is being developed by the Department is concentrating more and more upon modification of the environment so that it becomes unacceptable to the fly. Methods with this object can only be elaborated with the aid of a most intimate knowledge of the life of each species of fly, of the plants, the animals, and the climate in the habitat it prefers. The necessity for this knowledge has led to the amassing of a volume of co-ordinated ecological information that, at least for a tropical area, is without its equal. The appendices include a 10-page glossary of ecological, vegetal and other terms, and lists of plants and mammals, with their habitats, native names in several languages, and scientific names.

506. ON NEW ALEURODIDÆ (HEM). By G. H. Corbett. (*Ann. Mag. Nat. Hist.* [10], xvi., **92**, 1935, p. 240. From *Rev. App. Ent.*, xxiv., Ser. A, **10**, 1936, p. 635.) Includes a description of *Bemisia goldingi* on cotton in Nigeria.

507. ON SOME PARASITES FOUND IN ASSOCIATION WITH THE STEM WEEVIL PEST OF COTTON IN SOUTH INDIA (*Pempheres affinis*, F.) AND THEIR RÔLE IN ITS BIOLOGICAL CONTROL. By T. V. R. Ayyar and V. Margabandhu. (*Madras Agr. J.*, 24/3/1936, p. 102. From *Exp. Sta. Rec.*, 75, **6**, 1936, p. 818.)

508. INTRODUCTION TO RESEARCH ON PLANT DISEASES. A GUIDE TO THE PRINCIPLES AND PRACTICE FOR STUDYING VARIOUS PLANT-DISEASE PROBLEMS. By A. J. Riker and R. S. Riker. (Pubd. by the authors, Univ. of Wisconsin, 1936. Price $2.65. Mimeographed. From *Rev. App. Mycol.*, xvi., **2**, 1937, p. 113.) This manual is designed primarily as a reference text of selected technique for research workers and advanced students. The eleven chapters deal with " the foundation of a research problem; general laboratory equipment; culture media; certain physico-chemical measurements; isolation, culture, and inoculation; virus diseases; certain procedures for pathological history;

epidemiology, environment, and control; statistical analyses; records and manuscripts; and laboratory exercise topics"; each is succeeded by a bibliography of the relevant literature. The work is eminently of service to students entering upon research, besides providing a useful reference book for experienced scientists.

509. SOME NOTES ON THE INCIDENCE OF DISEASE AND RESISTANCE TO PATHOLOGICAL AND OTHER ADVERSE CONDITIONS IN CROPS OF SIND. By K. I. Thadani. (*Proc. Ind. Acad. Sci.*, iii., **6**, 1936. From *Rev. App. Mycol.*, xvi., **2**, 1937, p. 97.) In the course of plant-breeding work in Sind it was observed that most of the imported American cotton varieties possessing leathery, glabrous leaves are susceptible to red leaf, but strains 289 F-1 and 4 F-98, derived from Sind-American cotton varieties, are very resistant. The Egyptian and Sea Island cotton varieties tested in Sind show leaf crinkle, but three improved strains—viz., Ashmouni 37, Boss III-16, and Sea Island 2-4—have been produced, and can be grown successfully in Lower Sind.

510. THE EFFECT OF CRAZY-TOP DISORDER ON COTTON PLANTS AND ITS CONTROL BY IRRIGATION MANAGEMENT. By C. Hope *et al.* (*U.S. Dpt. Agr. Tech. Bull. No.* 515, 1936. From *Exp. Sta. Rec.*, 76, **2**, 1937, p. 201.) This account gives the history of the disease, notes its occurrence in Pima cotton at the seed farm, Sacaton, Arizona, describes the symptoms, and gives the results of studies involving the physiology and morphology of the disease, the chemical composition of normal and diseased plants and plant parts, and the results of irrigation experiments.

Probably because of their higher sterility, crazy-top plants attained greater height than normal ones, but the bracts and petals averaged smaller. A large proportion of the bolls reaching maturity on affected plants showed injurious effects of the disorder. Various forms of cross grafting and budding between normal and affected plants failed to transmit the disease. The chemical analyses suggested that imperfect translocation of nutrients to the immature fruits of affected plants may influence the excessive shedding of squares and bolls and the poor development of the bolls that are retained. Apparently there was a tendency for the ash constituents and nitrogen to decrease with approaching maturity. Applications of various fertilizer elements and of chemicals such as ferrous manganese, or zinc sulphates, or borax were ineffective in preventing or controlling the disorder.

The results of the irrigation experiments indicated that the incidence of crazy-top was related in some way to the checking of growth from water shortage, and the resumption of growth with restoration of abundant moisture. It is not indicated, however, that water shortage is the only factor involved in inducing the abnormalities characterizing the disorder. The information at hand suggests the practicability of preventing crazy-top on these highly calcareous soils by irrigating with sufficient frequency to prohibit a checking of growth during the summer months.

511. A PODRIDÃO INTERNA DOS CAPULHOS DO ALGODOEIRO NO ESTADO DE SÃO PAULO. By H. P. Krug. (*Bol. Tech. Inst. Agron. Campinas No.* 23, i., 1936.) OS "MANCHADORES" DO ALGODÃO (*Dysdercus* spp.). By L. O. T. Mendes. (*T.c.*, ii. With summaries in English.) (From *Rev. App. Ent.*, xxv., Ser. A, **1**, 1937, p. 18.) The first paper includes a review of the geographical distribution, economic importance, and symptoms of internal boll-rots of cotton caused by fungi, particularly *Nematospora*, and bacteria, and an account of preliminary studies of them in São Paulo, Brazil, where they are of minor importance. In the second paper, the world distribution of bugs of this genus is recorded, and it is stated that about ten species occur in Brazil and at least three in São Paulo.

Their specific names are not given. They occur on cotton and other plants, chiefly Malvaceæ, and have been found to develop from egg to adult in 5-6 weeks. An account is given of the injury to cotton caused by the associated boll-rots.

512. *L'Eremothecium ashbyii*, NOUVEAU CHAMPIGNON PARASITE DES CAPSULES DU COTONNIER. By A. Guilliermond. (*Rev. Mycologie*, N.S., i., **3**, 1936. From *Rev. App. Mycol.*, xv., **11**, 1936, p. 719.) An expanded account is given of the author's study of the fungus isolated from cotton bolls by Massey in the Sudan, and referred to (without a Latin diagnosis) as *Eremothecium ashbyii*.

[*Cf.* Abstrs. **595**, Vol. IV., **419**, Vol. VI., and **609**, Vol. XII. of this Review.]

513. TESTS OF THE TOXICITY OF SULPHUR COMPOUNDS TO THE GROUP OF BACTERIA CAUSING ROTS OF VEGETABLES AND SPOTTING OF TOBACCO, FRENCH BEANS AND WHEAT, AND GUMMOSIS OF COTTON. By A. A. Kapshuk. (In Russian.) (*Summ. Sci. Res. Wk. Inst. Pl. Prot.*, Leningrad, 1935. From *Rev. App. Mycol.*, xvi., **1**, 1937, p. 35.) Field experiments in 1934 in North Caucasus showed, *inter alia*, that cotton seed naturally infected with *Bacterium malvacearum*, which was exposed for seventy-two hours to an atmosphere containing 750 gm. hydrogen sulphide per cubic metre enclosed space, gave rise to plants that showed only 1·25 per cent. gummosis, as against 18 per cent. in the crop from untreated seed; formalin (1 in 100) treated seed gave 1 per cent. infection at the same stage. Hydrogen sulphide caused a serious discoloration of the two cotyledonary leaves at first, but on the whole had a stimulatory effect on the growth of the plant.

514. THE SIGNIFICANCE OF THE FUNGUS DISEASE COTTON WILT IN PERU. By M. E. Odriozola. (In Spanish.) (*Bol. Co. Admin. Guano*, 11, **8**, Lima, 1935. From *Exp. Sta. Rec.*, 76, **2**, 1937, p. 201.) A general discussion of the disease and factors influencing its depredations in Peru, including the question of resistant varieties.

515. POTASH AND COTTON WILT IN CENTRAL AND NORTH MISSISSIPPI. By L. E. Miles. (*Better Crops with Plant Food*, 20, **10**, 1936. From *Exp. Sta. Rec.*, 76, **2**, 1937, p. 201.) Tests are described showing the effects produced by potash on soils of various types in the State. In one test, with an increase in potash from 0 to 8 per cent., with the proportion of nitrogen and phosphorus remaining constant at 4 and 8 per cent. respectively, the average wilt infection was reduced from 31·67 to 7·81 per cent., and the average yield of seed cotton per acre was increased from 496·9 to 896·23 lb. Similar increases in the nitrogen content reduced the wilt infection only from 11·52 to 8·74 per cent., with a yield increase of only 28·46 per cent., while increases in the phosphorus content from 4 to 10 per cent. appeared to have relatively little influence on the amount of infection.

[*Cf.* Abstr. **316**, Vol. XIV. of this Review.]

516. RÔLE OF INSECTS IN THE DISTRIBUTION OF COTTON WILT CAUSED BY *Fusarium vasinfectum*. By J. J. Taubenhaus and L. D. Christenson. (*J. Agr. Res.*, 53, **9**, 1936, p. 703.) The following cotton insects were caged and fed on roots, stems and leaves, or bolls of cotton plants infected with typical fusarium wilt: *Melanoplus femur-rubrum*, *M. differentialis*, *Schistocerca americana*, *S. obscura*, and other less abundant grasshoppers; the larval stages of *Alabama argillacea*, *Laphygma frugiperda*, and *Prodenia ornithogalli*; a number of species of white grubs; and the larval stage of *Ataxia crypta*. Viable *F. vasinfectum* was recovered from fecal pellets or entire insects cultured on potato-dextrose agar in Petri dishes. The wilt fungus could not be recovered from, and was apparently destroyed while passing through, the alimentary tract of wireworms, Collembola, and Japygidæ. Viable *F. vasinfectum* was recovered from cultures of the entire insects or of fecal pellets dissected out from the recta of numerous species collected in badly wilted cotton fields in Texas. The following insects were found to act as natural carriers of the cotton wilt fungus: *Melanoplus differentialis, M. mexicanus, M. femur-rubrum, Encoptolophus texensis, Spharagemon cristatum, Tomonotus aztecus, Chortophaga viridifasciata* var. *australior, Schistocerca americana, S. obscura, Trimerotropis citrina,* and *Dissosteira carolina.* It still remains to be proved whether the boll weevil can act as a carrier of fusarium wilt of cotton. Cotton seedlings were successfully inoculated with strains of *Fusarium* isolated from the alimentary tract of insects, and with a pure culture of *F. vasinfectum* from infected cotton. *F. vasinfectum* has survived for fifteen months in fecal pellets from grasshoppers fed on wilt-infected cotton stems and kept dry in the laboratory. It is suggested that these results may help to explain the occasional finding of infected plants in areas where the disease does not ordinarily occur.

517. A RAPID INDIRECT METHOD FOR DETERMINING THE WILTING COEFFICIENT OF SOILS. By G. J. Bouyoucos. (*J. Amer. Soc. Agron.*, 28, **7**, 1936, p. 581. From *Exp. Sta. Rec.*, 76, **1**, 1937, p. 160.) Evidence is presented of the close agreement between wilting-point and moisture content critical for freezing. A rapid and convenient procedure is described for determining, by means of a Beckmann thermometer, the depressions of freezing-point in soils in a series of soil samples of successively decreasing, and definitely known, moisture contents. One of the most striking things revealed by the results given is the extreme sensitiveness of the freezing-point depression as the moisture content decreases. At the higher moisture contents a decrease of 5 per cent. moisture may cause an increase of only 0·012° C. in the freezing-point depression, but at the lower moisture contents, and especially near the critical water content where solidification fails to take place, a decrease of only 2·5 per cent. moisture may cause an increase of more than 1° in the freezing-point depression. This extreme sensitiveness of the freezing-point depression to the water content at the lower moisture contents is of great practical importance, for it makes possible the determination of the wilting coefficient by the freezing-point method with an accuracy of about 1 to 2 per cent. It is shown that "the difference in the moisture content between the points where a freezing-point determination can and cannot be made is only 2·5 per cent." By estimation this amount can be reduced to about 1 per cent., which would represent a very high accuracy in determining the wilting-point indirectly and rapidly.

518. RECENT WORK ON THE PLANT VIRUSES. By K. M. Smith. (*Curr. Sci.*, 4, **8**, India, 1936, p. 565. From *Exp. Sta. Rec.*, 76, **2**, 1937, p. 194.) This is a general review.

519. ON THE CLASSIFICATION OF PLANT VIRUSES. By J. M. Birkeland (*Phytopathology*, 26, **5**, 1936. From *Exp. Sta. Rec.*, 76, **3**, 1937, p. 340.) A comparison of results obtained by the serological reactions of plant viruses and their induced or acquired immunity reactions in plants indicated (1) that viruses inducing complete cross immunity are serologically indistinguishable, (2) that those giving partial cross protection are serologically related, and (3) that viruses giving no cross protection are serologically unrelated. The possibility of using serological reactions and induced plant immunity reactions for elucidating the natural relationships of viruses is indicated.

520. FIRST SUPPLEMENT TO THE HOST INDEX OF VIRUS DISEASES OF PLANTS. By M. T. Cook (*J. Agr.*, xx., **3**, Puerto Rico, 1936. From *Rev. App. Mycol.*, xvi., **2**, 1937, p. 114.) This supplement to the author's host index of plant virus diseases adds 10 families, over 50 genera, and about 105 species to the original work.

[*Cf.* Abstr. **659**, Vol. XIII. of this Review.]

521. VIRUS AND GENIC REACTIONS IN MORPHOGENETIC, PHYSIOGENETIC, AND PHYTOGENETIC ASPECTS. By D. Kostoff. (*Phytopath. Z.*, ix., **4**, 1936, p. 387. From *Rev. App. Mycol.*, xvi., **2**, 1937, p. 115.) An attempt is made to present a comparative study and discussion on the nature and activity of viruses and genes on the basis of original observations and those of other workers in the same field. A number of analogies are drawn between these two ultra-microscopic entities, which appear, for instance, to belong to the same physico-chemical category of particles and to produce similar effects (systemic or local) in plants. Certain phenomena, such as variegation, may proceed either from viruses or from genes, while both groups share antigenic properties. Although it would be premature to claim that any proof is yet forthcoming of identity between viruses and genes, a clue to further studies along these lines is thought to have been afforded by the present, admittedly preliminary, investigations.

522. ALLGEMEINE MERKMALE DER VIRUSARTEN. By R. Doerr. (*Z. Hyg. Infekt. Kr.*, cxviii., **6**, 1936, p. 738. From *Rev. App. Mycol.*, xvi., **2**, 1937, p. 114.) A report of a lecture, delivered at the Second International Congress of Microbiology, held in London in July, 1936, on some of the outstanding general features of the ultra-microscopic viruses, including bacteriophage, presented and critically discussed in the light of current researches. The author does not concur in the view that the viruses represent a natural entity of biologically uniform groups of infective principles, the evidence in favour of this hypothesis at the present stage being, in his opinion, unconvincing.

523. FACTORS AFFECTING THE AMOUNT OF INFECTION OBTAINED BY APHIS TRANSMISSION OF THE VIRUS HY. III. By M. A. Watson, Rothamsted. (*Phil. Trans. B.*, vol. 226, December, 1936, p. 457.) Experiments were carried out to show the effect of various factors on the percentage of infection obtained with the virus Hy. III. in tobacco, using its insect vector, *Myzus persicæ*. A maximum infection was obtained in winter, a minimum in summer. Percentage infection increases with the number of aphids used per plant, and the infections are local and independent. *Myzus persicæ* is capable of infecting two consecutive plants without intermediate access to a source of infection, but the number of second infections decreases rapidly with increasing time on the healthy plant, and is negligible after an hour.

GENERAL BOTANY, BREEDING, ETC.

524. SCIENCE OF THE YEAR 1936: THE BIOLOGICAL SCIENCES. By W. B. Brierley. (Reprint received from the author.) A useful and interesting summary of the work of the year in connection with Human Evolution, Zoology, General Physiology, Botany, Microbiology and Disease.

525. BOTANY'S IMPORTANCE IN THE ECONOMIC SPHERE. By W. B. Brierley. (Reprinted from *Ency. of Mod. Knowledge*, **29**, 1937, p. 2713.) A useful brief account of botany's economic importance given under the following headings: Botanical specialization; ravages of parasites; defeating plant diseases; importance of forestry; cotton's place in economics; study of grasses, fruits, oils and spices; value of research, etc.

526. A HANDBOOK OF STATISTICS FOR USE IN PLANT BREEDING AND AGRICULTURAL PROBLEMS. By F. J. F. Shaw. (*Imp. Coun. of Agr. Res., India.* Issued 1936. Price Rs. 4-6 or 7s. 3d.)

527. REGISTRATION OF IMPROVED COTTON VARIETIES—I. By H. B. Brown (*J. Amer. Soc. Agron.*, **28**, 1936, p. 1019. From *Pl. Bre. Absts.*, vii., **3**, 1937, p. 317.) Brief accounts are given of the varieties Deltapine, Ambassador and Washington, bred by commercial firms.

528. CLAVE ILUSTRADA DE LAS ESPECIES CULTIVADAS DEL GENERO GOSSYPIUM. By E. C. Clos *et al.* (*Trab. del Lab. de Agr. Esp. No.* 3. Facultad de Agr. y Vet., Buenos Aires, 1936.) An illustrated key to cotton varieties.

529. BREEDING WORK, GENETICS AND PHYSIOLOGY OF COTTON. (*Pubn. No.* 4 of the Lenin Acad. of Agr. Sci., Moscow, 1936.) This report contains the papers (in Russian) on the breeding, genetics and physiology of cotton, read at the Conference of the All-Union Lenin Academy of Agricultural Sciences held in January, 1935.

530. MUTATIONS AND NATURAL SELECTION. By R. R. Gates. (*Amer. Nat.*, **70**, 1936, p. 505. From *Pl. Bre. Absts.*, vii., **3**, 1937, p. 289.) In this survey numerous instances are given of mutant forms which have been able to establish themselves apparently without the aid of natural selection. The widespread occurrence of parallel mutations is emphasized, and it is pointed out that here again in many cases natural selection has played no part.

531. A POSSIBLE BASIS OF SELECTING PARENTS FOR CROSSING. By N. V. Lazarev. (*Selek. i. Semen.*, **10**, 1936, p. 32. From *Pl. Bre. Absts.*, vii., **3**, 1937, p. 291.) As a basis for research on hybridization the possibilities of applying vernalization to all the main crops is suggested. It is the experience of the author that certain genotypes possessing a particular character in an " intense degree " will show a high percentage of transmission of the character to their progeny. Parent plants should be chosen exhibiting the desired character very markedly. In order to identify those forms likely to transmit a certain character with a high degree of certainty, it is suggested that large numbers of combinations and a relatively small number of F_2 plants should be used in preference to fewer combinations and a large F_2. Satisfactory results in testing combinations have been obtained with 200 F_2 plants. The plants exhibiting a high degree of the desired character could be identified in the F_2.

532. INTERVARIETAL CROSSING OF SELF-POLLINATED PLANTS. By T. D. Lysenko. (In Russian.) (*Sot. Rekon. Sel' Skogo Khoz.*, **10**, 1936, p. 70. From *Pl. Bre. Absts.*, vii. **3**, 1937, p. 288.) The author believes that continued self-fertilization leads to degeneration, and that this, like sterility and other deficiences encountered in inbreeding, is not due to the segregation of genes—for the gene concept is a fallacy and a hindrance to practical work—but rather to a too great similarity of the gametes. Diversity of the gametes can be caused by diversity of the environment of the plants producing them, and so by crossing different plants in a variety the original vigour is restored. By this method improved varieties can be produced from old ones in a much shorter time than is required by more orthodox methods. In laying down a theoretical basis for his method the author breaks away from the theories of classical genetics and emphasizes the importance of a plant's environment on the gametes it produces.

533. ROW COMPETITION AND ITS RELATION TO COTTON VARIETIES OF UNLIKE PLANT GROWTH. By N. I. Hancock. (*J. Amer. Soc. Agron.*, **28**, 1936, p. 948. From *Pl. Bre. Absts.*, vii., **3**, 1937, p. 292.) Row competition was induced in a study of California Acala and Delfos 6102 by means of an experiment in which different combinations occurred of single-row plots of the two varieties. Thus, for example, a comparison of Acala grown in three adjacent rows with a single row of Acala bordered by two rows of Delfos was possible. The trials were carried out for four years. The principal result was an effect from unequal plant growth in the Acala combinations. It is suggested that two-row plots be used for cotton varietal trials on medium fertile soil.

534. THE GENETICS OF COTTON—XVII. INCREASED MUTABILITY OF A GENE IN *G. purpurascens* AS A CONSEQUENCE OF HYBRIDIZATION WITH *G. hirsutum.*

By S. C. Harland. (*J. of Genetics*, xxiv., 1, 1937, p. 153.) The gene S^H (*hirsutum* petal spot) is slightly mutable somatically on (*a*) a *hirsutum* background, and (*b*) a background predominantly *barbadense*. The gene S^P (*purpurascens* petal spot) becomes increasingly mutable, both somatically and gametically, *pari passu* with the replacement of *purpurascens* by *hirsutum* genes. It is believed that species may possess modifier complexes, the effect of which is to preserve the stability of genes and prevent them from mutating at an excessive rate. *Hirsutum* and *purpurascens* may be assumed to differ in the nature of such of their modifiers as affect the mutation rate of S^P. The genes S^H and S^P are members of the anthocyanin multiple allel series, and may be distinguished by the weaker manifestation of S^P in the *hirsutum* genotype. Other cases of mutability in interspecific hybrids are mentioned, and the possible significance to the plant breeder of mutability consequent on interspecific hybridization is referred to.

535. RECENT ADVANCES IN CYTOLOGY. By C. D. Darlington. (J. and A. Churchill, Ltd., London, 1937, 2nd ed., 21s. From *Pl. Bre. Absts.*, vii., 3, 1937, p. 341.) This second edition differs from the first in having a different plan and in incorporating the advances made in the interim. It also includes some modifications of the author's ideas which have been occasioned by pertinent criticism or by new evidence (*e.g.*, on the function of the nucleolus). The range of topics is very similar to that of the first edition. Instead, however, of the last chapter being devoted to the evolution of genetic systems, the whole account has been "recast in terms of evolution." The chapter is now devoted to cell mechanics, including among other interesting topics an account of the author's "Balance Theory of Mitosis." The value of the book as a reference work is increased by the tables and diagrams interspersed throughout the text and by the immense bibliography of over 1,500 references. There are also a useful appendix on interpretation, a somewhat enlarged glossary, and a comprehensive index.

536. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d., post free.) The fourteenth number of Series A Genetics has recently been issued, and contains the following paper reprinted from the *Journal of Genetics*:

CYTOLOGICAL STUDIES IN COTTON. Pt. IV. "Chromosome Conjugation in Interspecific Hybrids." By A. Skovsted. The following new species hybrids were recorded: *Gossypium armourianum* × *G. aridum*, *G. armourianum* × *G. tribolum*, *G. Sturtii* × *G. armourianum*, *G. anomalum* × *G. tribolum*, and New World cottons × *G. anomalum*. The two first-mentioned hybrids are partly fertile. The chromosome conjugation was studied in these hybrids and in those described earlier. Results obtained from the average chromosome conjugation in about twenty pollen mother cells in each hybrid are summarized in Tables 21-23.

Subdivision of the genus *Gossypium* in the following three cytological groups was confirmed: (A) species with $2n=26$ from America and the neighbouring Pacific Islands; (B) species with $2n=26$ from Africa, Asia and Australia; (C) New World cottons with $2n=52$ from America and Islands in the Pacific Ocean.

Hybrids within each of the three groups are characterized by almost normal chromosome conjugation compared with hybrids between the groups. Combinations between groups (A) and (B) showed variable but incomplete conjugation. All the hybrids between groups (C) and (A) showed similar chromosome conjugation close to 13 univalents + 13 bivalents. Combinations between groups (C) and (B) vary considerably; the number of conjugated chromosomes ranges from an average of 0·55 bivalents in New World cottons × *G. Stocksii*, 2·6 in New World cottons × *G. anomalum*, 3·1-7·6 in New World cottons × *G. Sturtii*, while in the hybrid Asiatic cottons × New World cottons the numerical chromosome configurations were similar to those in hybrids between groups (C) and (A).

The inference was drawn that the genus *Gossypium* is probably of monophyletic origin, but an early geographical separation took place into the two groups (A) and (B). These developed independently in different directions and finally lost most of their chromosome homology.

The origin of group (C) New World cottons with $2n=52$ is discussed, and further evidence supporting the hypothesis of an origin from a hybrid between Asiatic cottons and an American wild species has been advanced.

Certain triangular hybrids deviate cytologically from expectation. These are explained as the result of quantitative difference in chromosome homology.

The average chiasma frequencies per bivalent show positive correlation with the intensity of chromosome conjugation.

Secondary pairing in American wild species indicates that 6 is the basic chromosome number.

Conformity is shown in chromosome numbers and geographical distribution between the genus *Gossypium* and the allied types *Gossypioides* and *Kokia*.

537. VARIATION IN THE CHARACTER OF COTTON IN RELATION TO THE POSITION OF BOLLS ON THE PLANT. By K. R. Sen and M. Afzal. (*Ind. J. Agr. Sci.*, vii., **1**, 1937, p. 35.) *Summary.* Bolls appear to possess a critical age within which the odds are heavily against their living up to maturity. The percentage of boll-shedding at any time of the flowering period seems to depend almost directly on the mean moisture percentage of the atmosphere. By analyzing the data it is found that fibre properties do not depend on the position of the boll on the plant as such, all observed fluctuations being explicable with reference to the effect of climate.

538. THE MIGRATION OF SOLUTES. By T. G. Mason and E. Phillis. (Reprinted from *Bot. Rev.*, iii., 1937, p. 47.) The subject is discussed under the following heads, and the literature is reviewed: (A) The export of mineral elements from the root; (B) the export of carbohydrate and mineral elements from the leaf; (C) the interchange of solutes between tissues. No attempt is made to discuss the movement of hormones and related substances.

539. COTTON FLOWER PIGMENTS: COMPOSITION. By K. Neelakantam and T. R. Seshadri. (*Proc. Indian Acad. Sci.*, 4A, 1936, p. 54. From *Summ. of Curr. Lit.*, xvii., **4**, 1937, p. 106.) The authors have extended their studies to the golden-yellow petals of Karunganni cotton. The pigment consists mainly of quercimeritrin and gossypitrin.

[*Cf.* Abstr. **485**, Vol. XIII. of this Review.]

FIBRES, YARN, SPINNING, WEAVING, ETC.

540. COTTON BALE ENQUIRY. (*Int. Cott. Bull.*, xv., **58**, 1937, p. 213.) For many years past the International Federation has constantly been receiving enquiries concerning the weights, densities, measurements, details relating to covering and banding of cotton bales produced in various parts of the world. During last summer a questionnaire was sent round to all cotton-growing countries, and the useful information given in the replies is tabulated.

541. COTTON FIBRE: MATURITY DETERMINATION BY THE POLARIZING MICROSCOPE. By E. R. Schwarz. (*Cotton*, U.S., 101, **1**, 1937, p. 60. From *Summ. of Curr. Lit.*, xvii., **7**, 1937, p. 189.) A popular account is given of the fundamental principles underlying the polarizing microscope, and its use in the determination of the maturity of cotton samples. A table summarizes the appearance of the fibres for different " maturities," and in different orientations, and a second table shows the method of obtaining the maturity rating assuming arbitrary factors for degree of immaturity. Some illustrative examples are discussed.

542. LENGTH-DIAMETER RELATIONSHIPS IN COTTON FIBRE. By O. A. Pope. (*Arkansas Sta. Bull.* 327, 1936. From *Exp. Sta. Rec.*, 76, **2**, 1937, p. 180.) The relationship between fibre diameter and length of fibre within a sample was studied in Arkansas 17, Delfos 531, Rowden 2088, and Half and Half cottons, these representing lengths of staple commonly grown in the major part of the Cotton Belt. In field sampling, one lock was picked from each of 100 plants selected at random from the plats. Consideration of all data indicated a genetic basis for the length-diameter relationship, but that seasonal conditions can modify certain of these factors significantly. There is no generalized relationship between length and diameter in the fractioned sample of different varieties. The diameter-ratio indicated that within the same sample a distinct tendency exists for the larger fibres to have a greater proportional amount of secondary cell wall thickening than the smaller fibres. There seemed to be no well-defined relationship of diameter to mean length of the variety.

543. VARIABILITY OF FIBRE LENGTH IN A RELATIVELY UNIFORM STRAIN OF COTTON. By T. R. Richmond and H. J. Fulton. (*J. Agr. Res.*, 53, **10**, 1936, p. 749.) With samples from a commercial strain of Pima cotton, fibre-sorting methods were developed which materially reduced the time required for making fibre arrays of cottons of the Egyptian type. The mean and the upper quartile length, which were determined from fibre arrays from the same seeds, were found to be highly correlated, as were the mean and the combing length. The differences from sample to sample on the plant and from plant to plant in the row were insignificant, and analysis of variance showed that the samples could be considered as coming from a homogeneous population. Of the total variance in fibre length, as determined from sorting the fibres on the seed, the variance on the individual seeds contributed 98 per cent., leaving the remainder attributable to that which occurred among the means of samples on the plant and among the means of plants in the row. The recognition of the amount of variance that is due to the variation in the fibre length on the seed raises questions as to the definition of the term " uniform fibre length " and the methods to be followed by the cotton breeder in cotton improvement work.

544. COTTON FIBRE TUFTS: BREAKING LOAD. By M. A. Grimes. (*Text. Res.*, **7**, 1937, p. 145. From *Summ. of Curr. Lit.*, xvii., **7**, 1937, p. 189.) A method for determining the breaking load of cotton fibres consists in cutting a flat, combed tuft about ¾ in. wide to a length of ½ in., weighing it (weight should be $0{\cdot}025 \pm 0{\cdot}005$ gm.), wrapping it between strips of adhesive tape that nearly meet across the middle of the tuft, and breaking between the jaws of a 2-inch cloth tester. Strength is recorded as the machine break area, area being given by weight (density × length). The method is claimed to be simpler than Chandler's bundle method, but to give comparable results.

545. FLAX-LIKE COTTON FIBRES: DISTINCTION FROM FLAX ULTIMATE FIBRES. By E. Slattery. (*J. M/c. Coll. Tech. Text. Soc.*, **26**, 1936, p. 16. From *Summ. Curr. Lit.*, xvii., **5**, 1937, p. 129.) Cotton fibres are sometimes encountered with transverse markings; they might be mistaken for the ultimate fibres of flax. In counts on samples of about 300 fibres the author has found as much as 26·27 per cent. of Bengals and Oomras cottons with these markings and from about 2·7 per cent. of the finer cottons. The fibres are readily distinguished from flax ultimate fibres by Miss Clegg's congo red staining test. The cotton fibres show typical spiral markings, but flax fibres a patchy red staining. When the stained fibres are kept in glycerol the spiral bands of cotton gradually merge into

a general staining. Sometimes parts of the cotton and flax fibres peel away; an illustration of a flax fibre shows three distinct layers.

546. Cellulosic Fibres: Structure. By W. K. Farr. (*Text. Res.*, **7**, 1936, p. 65. From *Summ. of Curr. Lit.*, xvii., **5**, 1937, p. 128.) A report of a lecture in which cellulosic fibres (including cotton) are considered as true cellulose particles embedded in a cementing material, probably containing pectic acid. The " cement " may be extracted with weak solvents such as ammonium oxalate, and the residual cellulose does not possess the viscosity in cuprammonium that is usually regarded as characteristic of cellulose fibres. Colloid properties of the fibres are ascribed to the " cement " and crystalline properties to the cellulose particles.

547. Cotton Hair: Development and X-Ray Structure. By W. Wergin. (*Angew. Chemie*, **49**, 1936, p. 843. From *Summ. of Curr. Lit.*, xvii., **5**, 1937, p. 128.) A report of a lecture on the application of X-ray spectroscopy to the study of cell wall development. The cotton hair does not display the true cellulose diagram until about the thirty-fifth day of growth. Up to this point, the diagram is characterized by two rings with d 4·20 and 3·75 Å, and is ascribed to a " primary substance." This gives place to cellulose, and its diagram finally disappears; the " primary substance " is operative in the lengthwise development of the hair and cellulose in the thickening of the hair wall. An interesting period for study appears to be the days following the thirty-fifth. Photographs of a hair on the forty-third day, in dark-ground illumination, show bright particles in rapid motion in the plasma. By focussing on the surface of the hair a striated structure like a chain of pearls is visible, oriented in the direction of the striations that can be observed on staining cotton with zinc chlor-iodide.

548. Cotton Plant Pulps: Production. By A. R. Macormac and F. K. Cameron. (*Ind. Eng. Chem.*, **29**, 1937, p. 96. From *Summ. of Curr. Lit.*, xvii., **7**, 1937, p. 177.) Results are presented of experiments on the pulping of the entire cotton plant by the soda and nitric acid processes. Before pulping, the ground plant was extracted and an oil was recovered from the extract. Both processes give a pulp with an α-cellulose content suitable for rayon manufacture. The pulp from the nitric acid process appears to be the better.

549. Reducing Spinning Costs. (*Text. Wkly.*, **19**, 1937, p. 368.) A discussion of the " Dawes " system which, it is claimed, enables a spinning frame to give a better quality product, a far wider range of counts, and a greater amount of yarn than is possible on any ring frame as at present constructed. This principle is a reversal of the orthodox methods now used. It commences building the package at the top of the spindle, and continues building in this position whatever the ultimate length of package may be. A hollow spindle is used, and working in conjunction with the spindle is a series of yarn carriers attached to a slidable sleeve. It is a combination of these three essential features that enables the principle to work so efficiently.

550. Cotton Spinning Mills: Machinery Requirements. By G. R. Merrill. (*Text. World*, **87**, 1937, p. 84. From *Summ. of Curr. Lit.*, xvii., **7**. 1937, p. 179.) The method of calculating the amount of machinery required for each stage in the production of cotton yarn is illustrated by a study of mills producing 13's warp yarn and 22's weft yarn.

551. Irregularity of Cotton Yarns. By A. J. Turner. (*Int. Cott. Bull.*, xv., **58**, 1937, p. 297.) Experiments strongly suggested that the chief source of yarn irregularities is to be sought in the very invention that caused cotton spinning to be a commercial success, namely, drafting by rollers. It is the irony of fate that this success was thus purchased at so high a price, for each process of drafting introduces numberless periodic irregularities; it is these that make it necessary to use the highest class cottons in spinning fine counts; no such restriction was known to the early Indian hand spinner, who could, and did, spin yarn of about 200's counts for Dacca muslins from cotton which could not be spun economically into 20's by machinery at the present day.

552. AUSTRALIAN AND AMERICAN COTTON: DYEING PROPERTIES. By H. A. Thomas. (*J. Soc. Dyers and Col.*, **52**, 1936, p. 325. From *Summ. of Curr. Lit.*, xvi., **21**, 1936, p. 612.) Evidence is described which shows that when equal percentages of direct, sulphur, vat and azoic dyes are applied to raw Australian and American cotton, the latter dyes, on an average, to a 3 per cent. stronger shade than does the Australian-grown cotton. Basic dyes give a slightly stronger shade on unmordanted Australian cotton than on unmordanted American cotton. An investigation is described of methods whereby this difference might be eliminated. It is shown that swelling treatment with caustic soda of a critical strength (22°-24° Tw.) followed by a treatment in 2° Tw. sodium hypochlorite solution prior to dyeing confers on Australian grown and American cotton the property of dyeing to approximately equal depths of shade with direct, sulphur, vat, and azoic dyes, and enables a full "bloomy" black to be obtained on Australian cotton. The causes of the above behaviour are believed to be that the majority of American cotton fibres are thicker and have thicker walls than most Australian types, and raw Australian cotton contains more foreign matter—*e.g.*, pectins, lignocelluloses, etc. The compensating treatment effects a swelling of the majority of the fibres of both species of cotton to the same wall thickness, and a removal of the vegetable impurities.

553. COTTON INDUSTRY ACTIVITY INDICES: CALCULATION. By M. J. Elsas and B. Ellinger. (*Text. Mfr.*, **42**, 1936, p. 463. From *Summ. of Curr. Lit.*, xvii., **3**, 1937, p. 84.) Criteria by which to judge the relative activity of the cotton trade, the "weighting" assigned to each factor, and the source of the necessary statistical information are discussed and indicated in a table. Four "indices" are suggested: (*a*) *Index of activity of industry*, based on returns of raw cotton deliveries, number of spindles in use, earnings of weavers, and number employed. (*b*) *Index of activity of export*, based on returns of yarn, thread and piece-goods. (*c*) *Index of prosperity of employed*, based on the number of employed multiplied by average wages. (*d*) *Index of prosperity of employers*, based on the share index of twelve leading firms (the July, 1914, share value as basis), the ratio of yarn price to raw cotton price, and the export value of yarn and cloth minus the price of raw cotton two months earlier. Figures are worked out for 1932-1935 in half-yearly periods, with the statistics for the end of 1935 as par (=100).

554. OPENING AND CLEANING MACHINERY. By T. C. Williams. (*Text. Wkly.*, **19**, 1937, p. 399.) A report of a lecture discussing the work carried out during the past few years by the British Cotton Industry Research Association at the Shirley Institute on the opening and cleaning of cotton and cotton waste, and of some new developments in cotton opening and cleaning machinery. Two machines patented by the Association—the Shirley Analyzer and the Shirley Lint Recoverer—are described. Work is being carried out on a third machine designed for cleaning raw cotton in bulk.

TRADE, PRICES, NEW USES.

555. COTTON, 1936. By John S. Dodd, M.P. (*Coml. Oldham*, February, 1937, p. 9.) Prior to September the industry did not show many signs of revival, but later considerable improvement was noticeable, and there is reason to believe it will continue in 1937. The Cotton Spinning Industry Act came into force on September 14, and the Spindles Board have purchased several idle mills; with the removal of a certain number of these from the market, the industry should ultimately reach a more stable position. Several price agreements have been reached in the spinning section, with a view to preventing the cut-throat competition that has caused losses of capital to the industry in the past. There are also signs of better understanding between the various members of the trade. The Textile Section of the British Industries Fair again proved satisfactory as a means for the trade to reach customers, particularly in the home market, and increased sales have resulted from exhibiting there. Design has improved in recent years, and the range of materials in cotton, silk, and rayon that Lancashire can offer to-day is greater than ever before.

556. REVIVING THE LANCASHIRE COTTON INDUSTRY. By B. Hesketh. (*Text. Wkly.*, xviii., 1936, Nos. 676, 710 and 739.) A survey of suggested remedies. Statistics are given of production and exports, and the influences of one-process opening, substitution of mules by ring-frames, automatic winding and beaming, automatic looms, bulk dyeing and finishing are discussed.

557. WORLD'S COTTON PRODUCTION AND CONSUMPTION. (*Int. Cott. Bull.*, xv., **58**, 1937, p. 208.) The U.S. Dept. of Agriculture estimates a record production of world cotton in 1937 of 29,100,000 bales, compared with 26,500,000 bales last season, and the previous record production ten years ago of 27,471,000 bales. If the estimates are realized, the United States will supply 40 per cent. of the world production this season. The total world mill consumption in 1936 was 26,800,000 bales, an increase of 6 per cent. over the previous season, and nearly 14 per cent. greater than the average for the ten years ended in 1933.

558. COTTON BUYING AND IMPORTING. By Col. W. A. Foulkes. (*Text. Wkly.*, **19**, 1937, p. 215.) An interesting lecture outlining the various processes through which the raw material passes in its journey from the cotton fields to the spinner.

559. COTTON: MARKETING. (*Spinn. u. Web.*, 54, **39**, 1936, p. 3. From *J. Text. Inst.*, xxviii., **2**, 1937, A61.) A general account is given of the most important types of cotton, methods of packing and marketing, and systems of classification. The usual method of purchasing and the use of futures contracts are illustrated by a study of examples.

560. NEW USES FOR AMERICAN COTTON. (*Cotton, M/c*, 15/5/37.) A recent report from Washington states that the Agricultural Adjustment Administration is prepared to donate surplus cotton or cotton fabrics to Federal, State and other governmental agencies and to non-profit organizations for the following uses: a covering, or as reinforcing material, for sides of irrigation, drainage, run-off or other type of ditches; to reinforce fills or cuts for roads, highways, etc.; a protection for hives of bees; a protective covering for fruits or vegetables, tree seedlings or shrubs; a portable covering, or tent, in connection with fumigating, spraying, or dusting fruits, vegetables, etc.; a membrane or reinforcing material in connection with the surfacing of airport runways, roads, bridges, paths or walks.

MISCELLANEOUS.

561. IMPERIAL INSTITUTE. The Annual Report for 1936 has recently been received. In the Plant and Animal Products Department 1,194 enquiries were dealt with, and reports furnished on 355 samples. In the Mineral Resources Department 927 enquiries were dealt with, and reports were made on 160 investigations, which involved the examination of 317 samples. 4,300 new books, official reports and pamphlets were added to the Library during the year.

562. The Imperial College of Science and Technology. The Twenty-ninth Annual Report contains the report of the Governing Body for the year ended July 31, 1936, and an account of the work of the various departments of the College. The total number of students registered was 1,024, or 26 less than the previous year. On the results of research work done at the College 82 higher degrees of the University of London were awarded, and 118 higher diplomas of the Imperial College, a total of 200. The number of B.Sc. degrees awarded to Imperial College students was 181, including 124 with Honours. 182 Associateships were awarded. The grand total of distinctions for 1935-36 was 563. In connection with the Appointments Board, of 213 students who had completed their studies and were ready for employment, 191 had obtained satisfactory work within a term or two of leaving the College. The titles of 211 papers published during the year are included in the report.

563. The Imperial College of Tropical Agriculture. The Principal's Report for 1935-36 records that the year under review was one of steady and normal progress. Long-range research on the four main crops of Trinidad—sugar-cane, cacao, bananas, and citrus—was continued, and the work is described. Brief accounts are also included of the investigations carried out by the Departments of Agriculture, Botany, Chemistry and Soil Science, Economics, Entomology and Zoology, and Mycology and Bacteriology. The total number of students in residence was 35. During the year 11 Associateships and 3 Diplomas were awarded. Forty-seven scientific papers were published, including those written for *Tropical Agriculture.*

PERSONAL NOTES

We very much regret to announce the deaths in May last of Sir Henry Birchenough, a Vice-President of the Council of the Corporation since its inception, and of General Arthur Birtwhistle, a member of the Administrative Council and of the Executive Committee for many years.

We tender our sincere congratulations to two members of the Council, Dr. R. B. Meek, on receiving the honour of Knighthood, and Mr. A. C. Nickson, on the honour of O.B.E., and also to Dr. R. H. Pickard, a member of the Research Committee, on receiving the honour of Knighthood, announced in the Coronation Honours List.

We offer our warm congratulations to Dr. T. G. Mason, Head of the Physiology Department of the Corporation's Cotton Research Station, Trinidad, on his recent election as a Fellow of the Royal Society.

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes " home " on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in

England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing the following officers are on leave in this country from cotton-growing countries:

Gold Coast	Mr. F. A. Robb.
„ „	Mr. J. M. Ward.
„ „	Captain J. McN. Wingate.
Kenya Colony	Mr. D. C. Edwards.
Nigeria	Mr. A. G. Beattie.
„	Mr. W. F. Gwilliam.
„	Mr. J. F. Ward.
Northern Rhodesia	Mr. F. J. S. Morkel.
Nyasaland	Dr. W. Small.
Tanganyika Territory	Mr. R. M. Davies.
„ „	Mr. J. G. M. King.
„ „	Mr. G. W. Lock.
„ „	Mr. G. B. Wallace.
„ „	Mr. N. M. Wight.
Uganda	Mr. W. J. Badcock.
„	Mr. D. S. Davies.
„	Mr. C. Hazel.
„	Mr. R. T. Wickham.
Zanzibar	Mr. A. J. Findlay.
West Indies: *Trinidad*	Mr. E. J. Wortley.

The following officers of the Corporation's staff abroad are on leave, or will shortly be arriving, in this country:

Nigeria	Mr. G. Browne.
Nyasaland	Mr. W. L. Miller.
South Africa	Mr. W. L. Fielding.
„ „	Mr. J. Marshall.
Southern Rhodesia	Mr. A. N. Prentice.
Sudan	Mr. R. L. Knight.
„	Mr. T. Trought.
West Indies: *St. Vincent*	Mr. S. H. Evelyn.
„ „ *Trinidad*	Mr. R. A. Silow.

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher

THE
EMPIRE COTTON GROWING
REVIEW

VOL. XIV. OCTOBER, 1937. No. 4

23-10
LIBRA

COTTON GROWING IN THE BELGIAN CONGO

BY

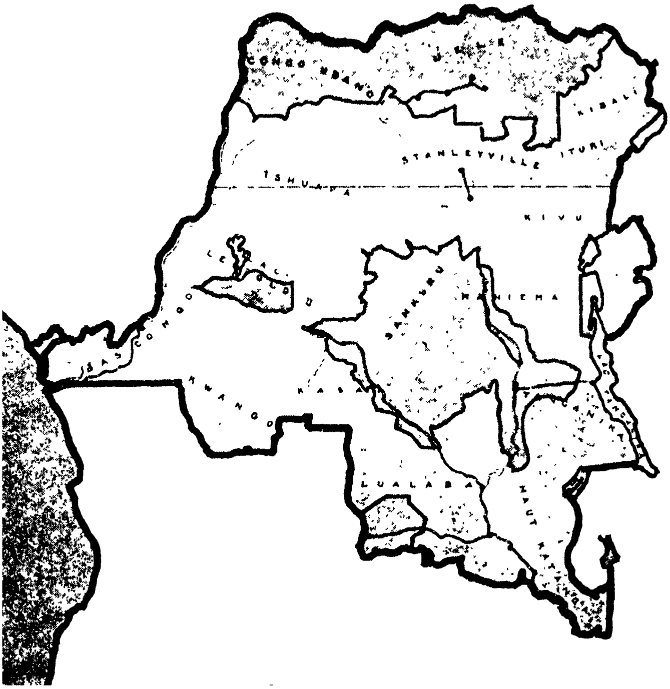
A. C. DE BAUW
Managing Director, Compagnie Cotonnière Congolaise.
Late Director of Industry and Commerce in the Belgian Congo.

THE output of native grown seed cotton in the Belgian Congo having reached this year the 100,000 tons mark (equivalent to 183,000 bales of 400 lbs. lint), it may be of interest to the readers of this Review to have a short account of the introduction and development of this crop in the Belgian Congo.

As in almost every other area in Central Africa, cotton was introduced in the Belgian Congo as a " cash crop "—*i.e.*, in order to provide with resources native communities which had no other means at their disposal. From a glance at the map it will be seen that the Belgian Congo covers an area extending from 5° north of the Equator to 13° south. Thus it has the advantage enjoyed by few cotton-producing countries of being able to market two crops each year.

The first experiments with cotton were carried out between 1914 and 1917 by Mr. Fisher, an American cotton expert, whose services had been obtained for the Belgian Government by the British Cotton Growing Association. The importance of securing in Africa new sources of supply was fully appreciated in Great Britain during the Great War, and we are still much indebted to Sir William Himbury for the help and advice which he generously gave at the time to Monsieur Ed. Leplae, Director-General of Agriculture at the Belgian Colonial Office. The work of Mr. Fisher enabled the Government to locate two regions north and south of the Equator where cotton appeared to be possible as a rain-grown crop. After several experiments, the Triumph Big Boll variety of American medium staple cotton was considered most suitable, and the distribution of seed to natives in "pioneer areas" was undertaken in 1918 by Administrative Officials, with the help and advice of Agricultural Officers.

It must be stated here that the introduction of this new crop was made under regulations, which empowered authorities within native areas to make the cultivation of certain food crops or export crops compulsory; the regulations simultaneously provided, however, that the crops were to be sold by the grower himself and solely for his own benefit. Such regulations are justified by the fact that the native population in the Belgian Congo is far more backward than other races of the west or east coast. Compulsion in this case is a means of educating the native, and it is intended that it should only be applied temporarily.



Map of Belgian Congo, showing Cotton-Growing Areas.

In view of the ready response given by natives to the Government's initiative, further areas were prospected, and it soon became evident that cotton could be grown in regions far away from railway or river transport, which entailed the establishment of an extensive network of motor roads. This was carried out with conspicuous success, especially in the Oriental Province, which soon became the principal producer of cotton in the Belgian Congo.

The first regulations relating to cotton cultivation and marketing were made in 1918. Anybody could buy cotton from native growers and gin it, and owing to high world prices ruling at the time, middlemen, while paying very little to the growers, sold cotton to the traders at an enormous profit, much to the detriment of the native. To correct this and at the same time to secure adequate ginning arrangements, it was deemed advisable to divide the cotton-growing areas into zones (the dimensions of which were subsequently limited to 75 miles in length and breadth), to be allocated on application to individuals or companies who would be prepared to comply with Government regulations and erect one ginnery to each zone. The equipment of the ginnery had to come up to certain specifications; all buildings, including the stores for seed cotton and lint, had to be of a permanent nature, and sufficient buying posts had to be erected by the licensee within the zone, so as to lighten as much as possible the task of the natives when marketing their crop.

Owing to the large amount of capital outlay imposed on the applicants and the risk attached to such undertaking, the Government gave them for a period of ten years (extended in 1932 to twenty years) the sole right to buy native-grown cotton in their area, provided that they undertook to buy *all* the cotton offered for sale by the natives within the said area, and to pay for it a minimum price fixed each year by the Governor-General. Natives growing cotton might retain it for their own use, or they could sell it outside this area if they wished to, but within the zone they could sell it to nobody else but the licensee or his agents.

On the basis of the above regulations embodied in the Cotton Decree of August 1, 1921, it was hoped to give a serious impulse to the cotton growing and ginning industry, which had been launched by the Government, with the result that in 1920 approximately 2,000 bales of lint were exported.

A company was formed in 1921 under the title of the Compagnie Cotonnière Congolaise with capital subscribed, after arduous endeavours, by Belgian bankers, cotton mills and commercial firms, who on the whole considered the venture as rather hazardous. The Government also took shares in this company for the value of the plant, material, etc., which it had erected in the " pioneer cotton areas " and had decided to pass on to the new company.

During the first three or four years progress was slow and the Company showed no profit. In 1925, however, the production of cotton in the Belgian Congo reached 17,000 bales, and from then onwards more interest was shown in the crop in Government as well as in commercial circles. Applications for cotton zones came forward, and a few companies took up cotton buying and ginning, either as a side line to commercial activities or as an exclusive occupation. In 1925 one undertaking was even formed with the object of exploiting cotton zones, as well as erecting at Léopoldville, the capital of the Belgian Congo, spinning and weaving mills to manufacture the locally grown staple. This was carried out with conspicuous technical success, and in 1931 the cotton buying and ginning departments of this company were sold to the Compagnie Cotonnière Congolaise.

Cotton activities in the Belgian Congo are now divided up amongst nine companies established in five out of the six Provinces of the country. In order to give some idea of their respective importance the following schedule has been drawn up, showing the number of ginneries owned by each and the quantity of seed cotton bought in 1936:

Companies.	*Area.*	*Number of Ginneries.*	*Seed Cotton Bought in* 1936 (*tons of* 2,240 *lbs.*).	*Equivalent in* 400 *lb. bales of lint.*
Compagnie Cotonnière Congolaise	North and South	78	54,000	100,000
Société Cotonnière du Népoko ...	North	8	7,000	13,000
Comptoir Colonial Belgika ...	„	8	3,800	7,000
Société Cotonnière du Bomokandi	„	6	6,000	11,000
Nieuwe Afrikaansche Handels Vennootschap	„	7	5,200	10,000
La Cotonnière Coloniale	South	5	6,050	11,300
Compagnie Commerciale Belgo-Africaine	„	3	2,200	4,200
Société Cotonnière du Tanganika	„	2	4,400	8,200
Compagnie de la Ruzizi	„	2	2,000	3,300
Totals ...	...	119	90,650	168,000

N.B.—Each ginnery is generally equipped with one or two 80-saw cotton gins.

As stated previously, cotton is grown in areas both north and south of the Equator. The first group covers the Uélé and Ubangi districts, which between them produce more than half of the total of the crop of the Congo. Sowing takes place from the middle of June to the end of July, while picking starts early in December and lasts until the end of March.

The southern group includes Sankuru, Lomami, Kasai, Maniéma, Lualaba, Dilolo (near the Angola border). The seed is planted here from the end of December until the beginning of February, and the picking season lasts from June to October.

A small area lying between Lake Kivu and Lake Tanganyika produces a long-staple cotton of 1⅛ inches (Allen Long Staple) which does very well; up to the present, however, the crop does not exceed 6,000 tons of seed cotton.

It should be stated that climatic conditions in the Belgian Congo are on the whole fairly normal, no area being specially subject to droughts or excessive rains. Rainfall varies according to districts from 48 inches to 75 inches per annum. Diseases have never been serious, and as a rule do not spread over large areas. Insect attacks have so far not been very severe; they are due mostly to stainers, helopeltis, or pink bollworm.

Thus, the development of cotton growing has been remarkably steady in the Congo, and but for the year 1932, when the area was restricted owing to the slump in world prices, the production has been increasing regularly, as shown in the following table:

Year.	*Production (400 lb. bales).*	*Year.*	*Production (400 lb. bales).*
1921	3,300	1929	40,000
1922	5,700	1930	56,000
1923	4,800	1931	82,000
1924	9,400	1932	43,500
1925	17,000	1933	85,000
1926	27,000	1934	108,000
1927	32,000	1935	142,000
1928	37,000	1936	168,000

Cotton experimental work has been carried out by Government ever since the introduction of cotton growing, and since 1934 the work has been taken over by the Institut National pour l'Étude Agronomique du Congo-Belge—a semi-state organization founded at the suggestion of King Leopold III. The activities of the Institute (I.N.E.A.C.) cover the whole field of scientific research in tropical agriculture, but there are two principal stations devoted exclusively to cotton experiments: one deals with the Northern areas and is established at Bambesa (Uélé), the other is at Gandajika (Lomami) and concentrates its work on the Southern cotton areas. An agreement has recently been arrived at with the I.N.E.A.C. which will result in the establishment of six or seven sub-experimental stations, the cost of which will be borne by the principal cotton companies.

Seed multiplication was previously carried out at seed farms at Government expense, but since 1936 the multiplication and bulking of improved seed has been carried out by native growers established in segregated areas, where the danger of mixing with ordinary seed is practically non-existent.

With the exception of supplies required by the Léopoldville spinning and weaving mills, which operate 10,000 spindles and 300 looms, all cotton produced in the Belgian Congo is shipped from Matadi (the seaport of the River Congo on the west coast) to Antwerp, where it is sold to Belgian or other Continental mills.

Before reaching Matadi, however, cotton has to be hauled a very long way by motor-lorries, river steamboats and by railways. The nearest cotton-growing area is 750 miles from the seaport, while the most distant is 1,650 miles away. Yet the arrangements between public carriers and the cotton companies work so smoothly that the crops are moved regularly all the year round in spite of falling water-levels or other seasonal obstacles.

The rates on cotton lint are adjusted in accordance with a sliding scale which ensures to the transport companies handsome returns when the selling price of cotton at home reaches a high figure. By way of compensation, the rates are reduced to a very low level—cost price or less—when quotations are down. This is a typical example of a policy which has been evolved in the Belgian Congo during the world crisis and extended to other produce, such as palm oil, palm kernels, coffee, etc.

On the whole it may be said that cotton growing has been successfully developed in the Belgian Congo, where it now occupies the largest place amongst exports of agricultural produce, with the exception of palm oil and palm kernels, which are obtained mostly from wild palm trees. This happy result is the consequence of constant and loyal co-operation between the cotton companies and their servants on the one hand and Administrative and Agricultural Officers on the other hand.

The industry being limited to a small number of concerns, it has been easy to conceive and to carry out a constructive policy. The nine cotton companies established in 1929 a board, known as the Comité Cotonnier Congolais, sitting in Brussels, where their delegates study, discuss and settle all matters of interest to the industry, and make either with Government or public carriers all necessary arrangements, which thus become binding on members of the cotton industry. Matters have been immensely facilitated by the spirit of "broad-mindedness and fairness to native and Government alike" which animates the Board, because cotton growing if it is to remain popular in Africa must ensure a fair share in the profit to all those who have an interest in the production.

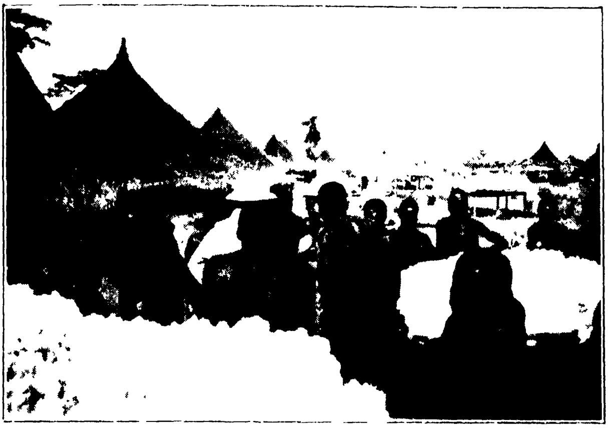


FIG. 1. —INSTRUCTING NATIVES HOW TO SORT COTTON BEFORE TAKING IT TO MARKET.

Note before each hut the racks made of bamboo used to dry and grade cotton.

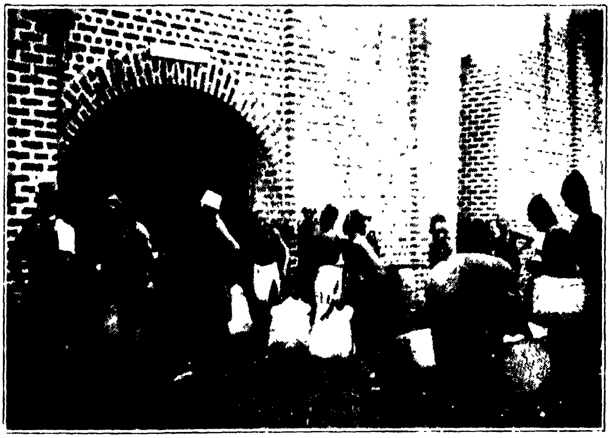


FIG. 2. BUYING COTTON AT A GINNERY.

On the right native inspecting cotton baskets.

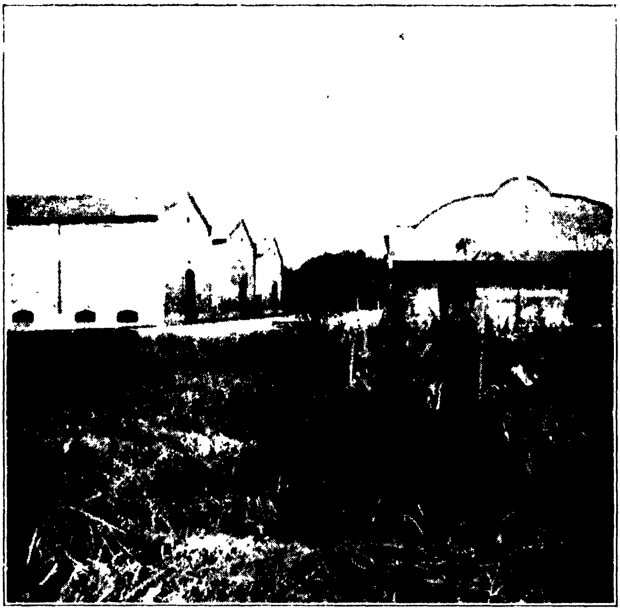


FIG. 3. GINNERY WITH THREE SEED-COTTON STORES (BRICKS AND CORRUGATED IRON), AT BUTA (UÉLÉ).

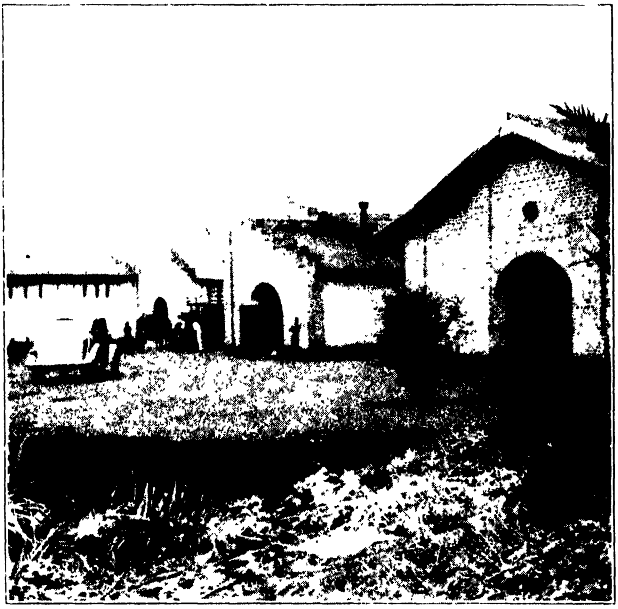


FIG. 4. GINNERY WITH COTTON STORES IN THE NEPOKO DISTRICT.

It is obvious that the welfare of the native agriculturist requires the existence of a strong and reliable European organization to buy his crop regularly at a fair price, regardless of world conditions. This is made possible with " cotton zones " the holders of which undertake specific obligations which are to the benefit of the natives in exchange for sole buying rights.

This organization of the cotton industry in the Belgian Congo enabled the Government in 1932 and 1933—when world prices of cotton fell to such low levels that export became unremunerative—to save native growers as well as cotton companies from ruin, by advancing to the latter money required to buy the crops. These advances, which had to be repaid by the borrowing companies out of their future profits, amounted at one time to £279,000. Interest was charged at a low rate and part of the advance was even made free of interest. Thanks to the ultimate recovery in prices, all advances were repaid within three years, while cotton growing in the Belgian Congo was spared the set-back which it encountered in many other countries as a consequence of the slump in prices.

This paper would not be complete without a few notes on the organization of propaganda amongst native growers, and on the method of fixing the purchase price of seed cotton.

Those who have lived in Central Africa know that any improvement in the native's ways of living or working requires long and patient efforts on the part of the educator. So it is with cotton growing and picking, which, although simple and easy, necessitate constant watching by those responsible for the welfare of the native community. Fields must be prepared in good time, sowings must be started and completed by a given date, weeding should be done in time, and when picking time comes good care must be taken to sort the cotton and to dry it before packing it into baskets.

In the Belgian Congo all this work is called "propaganda," and bearing in mind that it must reach a vast audience, Government have readily accepted the assistance of the European staff of the cotton companies.

As a rule each " cotton zone " and its attendant ginnery is in charge of a European employee. When cotton buying and ginning are over, this employee is placed by the company at the disposal of the Administrative Officer of the District. He is allotted a certain area within the zone, where he looks after the propaganda and reports to the Administration on its progress. Naturally the holder of a zone gladly helps in this work, as well as in the education of the native planter. He sees that the native gets the best seed; he even makes free distributions of implements, etc., because it all tends to a larger crop, of which he is eventually the sole buyer. In this way a spirit of mutual assistance inspires the work of the Administration and that of the cotton companies; it increases the rate of economic progress of the colony, improves agricultural methods, and secures for the native a better return for his work.

As regards the purchase price of seed cotton paid to the native, it should be fixed in such a way as to be fair to the producer and yet ensure a reasonable and sure return to the ginner. Neither the Government nor the native would be better off if the purchase price were so high that at the end of the season the ginner would be left with a loss or with such a small margin as not to compensate him for the risks involved. Because the industry must be sound and strong, all interested parties need security not for one month or one season, but for the whole period of tenure of the cotton zone. One should not forget that, regardless of distance or of quality, the owner of a zone has to buy all the cotton of each crop at a uniform price fixed for the whole season, and unlike the buyers in free markets, he cannot keep away from markets when there is not enough profit in sight.

Bearing these considerations in mind, the Government and the Comité Cotonnier Congolais have agreed to a sliding scale of "purchase prices and other incidental charges" to be based on the net selling price of the preceding crop. The 1938 crop, for example, will be paid for to the native grower, not on the basis of world prices ruling in January, 1938, but according to the average selling price obtained by the cotton companies for the 1937 crop, such price being checked by chartered accountants. Applied year after year, this method results in the regular adjustment of the price paid to the native on the basis of the actual selling price to the mills.

By a very practical and logical arrangement, the amount to be paid by the cotton companies according to the sliding scale is apportioned each year by the Governor-General as he deems best. The following figures apply to the purchase of the crop in the southern areas of the Belgian Congo in 1937.

According to the sliding scale, the total sum covering "purchase price and incidental charges" corresponding to the actual net selling price of the 1936 crop equals Frs. 3.76 per kilo of lint, it being assumed that 1 kilo lint equals 3 kilos seed cotton, or on the basis of a 33⅓ per cent. ginning outturn.

This sum of Frs. 3.76 per kilo of lint has been divided up as follows by decision of the Governor-General:

	Francs.
(*a*) Price paid in cash to the native (Frs. 1 per kilo seed cotton) ...	3.00
(*b*) Paid into the Road Fund covering upkeep, etc., of roads in cotton districts	0.10
(*c*) Paid into Native Treasuries—to cover social, medical, or educative expenses for the community	0.41
(*d*) Paid into the Implements Fund—to cover cost of hoes, axes, matchets, etc., issued free to natives	0.05
(*e*) Paid to Government as a refund of abatements granted on transport rates for cotton during world crisis	0.20
Total per kilo of lint ...	3.76

Besides these payments, the owner of a zone issues free to the grower 10 grammes of salt per kilo of seed cotton brought to the market, and allows a bonus of 2 centimes per kilo of seed cotton to the chief or headman for all cotton produced by his villagers.

Perhaps this will appear a rather complicated formula compared with the various systems in force in British cotton-producing colonies. It has undoubtedly the merit of introducing into the whole business of cotton growing and marketing, not only a great measure of stability, but also of fairness in the division of the profit. In practice the Belgian formula works without difficulty, and the amounts contributed to Native Treasuries, Road Fund and Implements Fund have been used with conspicuous success for the benefit of the whole native population in cotton-growing districts.

There is also a feature which perhaps is peculiar to the Belgian Congo; that is, the notification to the Authorities by the holder of the zone of the excess of seed cotton after ginning, worked out on the basis of the official ginning percentage. The value of any cotton delivered in excess at the time of purchase, through wrong weighing or any other cause, is then paid into the Native Administration Treasuries, as payment to the individual grower is obviously impossible.

However, in order to ascertain the advantages, if any, of the free markets over the zoning system, the Government of the Belgian Congo have lately opened up a new cotton-growing area where cotton may be bought by anybody, but not under a minimum price fixed by the authorities. This new order has been established for two years, and so far it has not shown any superiority over the zoning system; the total remuneration obtained by the native grower has on the whole been inferior to that in the cotton zones. It is yet too early to draw any conclusion from this experiment, which has been started without any preconceived idea.

It remains also to be seen how the free markets will stand the present depression in world cotton prices.

Received September, 1937.

WHAT KIND OF COTTON *DO* THEY WANT?

BY

F. T. PEIRCE, D.Sc.

The British Cotton Industry Research Association.

THOUGH it was still early in the morning, the pitiless sun of Tanganda struck down on a hot and bothered young man, as he stood by two cotton plants pondering. " These two remain of my hundred promising selections, and I must choose one for my seed plot. Heaven knows what wonderful cottons have gone west among the throw-outs, but whatever textile qualities they may have had, they failed on points I can judge. Some germinated badly, the bugs eliminated others for me, some yielded too little per acre, others had too small a ginning out-turn. It is hard enough to size up agricultural costs and the whims of the farmer; now come the notions of the spinner and the commercial value. The cotton must appeal to the spinner if we are to get the premium necessary; but these are new types, and though they might spin well, they may still make displeasing frocks or unserviceable overalls. Even if the first crop got a good price, a prejudice against our cotton arising two years later would leave us in the soup.

" I have been told to work for a market that demands a full inch staple, with good character. Both of these have a good halo, but I cannot be sure of their saintly character after the gin. Handsome is as handsome does. Their character will be shown by their behaviour in mill and use, but that is a slow and costly way of spotting a bad one. About all I can see is that this has upstanding curly hair, that one soft and silky. Probably there are all sorts of simple things that would show their character, but what are they, what do they mean, and how am I to pick them in the field ?" A gong rang through the clear air, the perplexed young man took a coin from his pocket, tossed it and picked the one with the curly locks.

This Mr. C. was an intelligent young man, not content to accept uncritically the varieties found suitable in other growing fields, nor to take his bulk seeds as the gin threw them out. But when he thought over the questions on which the success of his selection depended, he realized that his own wit was not enough; wider knowledge and experience were necessary. So he wrote to a friend near Manchester, put the questions up to him and sent some of the seed cotton. This Mr. A.—he bore the impressive initials B.C.I.R.A.—had microscopes, micro balances and skilful girls, and he knew the spinners and weavers well. He followed the behaviour of the cottons of Mr. C. and of the well-known varieties, saw how the spinner judged them and what he wanted, and set out to measure every feature of the cotton, counting its wrinkles, testing its clinging power, observing its regularity. These showed some relation both to the spinners' judgments and to the spinning behaviour, but there were exceptions and anomalies. Till "character" could be measured with certainty, he decided he had better judge cottons by spinning them.

Years have elapsed and the sun still shines on Mr. C., older and wiser, but still hot and bothered. Before him stand the experimental plants, most of them with curly locks, for the coin was a lucky one and its fall right—but he trusted its spin no longer. In his hand he held a report from B.C.I.R.A. on his cottons of the year before last, and he read: E.L., H.W./cm., N-D., H.S.W.C., S.D., z and columns of figures in fours. "Fine bit of work, no doubt," he thought. "It must have taken a lot of time and study. I will swot it up when I get back to headquarters, where I can look up what all these things mean. My Fisher is there too, and it will be some practice. One must be a statistician to grow cotton properly these days." His thoughts were interrupted by a boy who came running up with a letter from Mr. A., just arrived by air mail. It announced with justifiable pride that $r = 0{\cdot}9051$. "Fine," said Mr. C. "Anyway, we got our premium again last season; a wonderful thing, this scientific research. I wonder if the lady liked her frock and if the mechanic is still wearing his overalls. Now, how am I going to choose between these two plants?" and his hand went to his pocket.*

What, then, *is* the "character" of a cotton—the character that makes a fabric appeal to the ladies or stand hard wear, the character that makes it spin well and that for which a spinner will pay well, and the character that the breeder should seek? Are they all the same character? If not, how are these several characters related, and how may they be assessed?

They are certainly not all the same character, and some of the features on which they depend cannot yet be assessed. But enough is known of the measurable features to deduce the relative behaviour of different cottons in some important respects, with a probability much higher than the 1 in 2 chance of tossing for it—and even that is better than remaining undecided in action when there is no evidential basis of choice.

---

* Note to reviewers and other casual readers who may not know the E.C.G.C. The men of that body, systematic experimenters, rigorous statisticians, skilful geneticists, do not select cottons thus. This is a parable.

Cotton has too many uses and its economics are too complex to allow a constant value to each separate feature—length, fineness, strength, colour, etc. In a cotton blanket, a coarse short cotton gives a better nap, and more easily, than a fine one—it would be preferred even if the prices were the same. For underwear, a coarse cotton maintains the "ooziness" or airy softness desired, length is advantageous, and a natural white avoids the necessity for a wet treatment that rather spoils the ooziness. Poplin shirts have a beautiful lustre and handle if made from the longest, finest cottons. It just happens that these features also enhance tensile strength; they would be desirable in any case, and they do not increase resistance to abrasion, the usual form of wear in shirts. For hard wear, there seems a definite advantage in coarseness of fibre, provided the yarn is spun so coarse that no difficulties in spinning or handling come into question. The high fabric strength due to fine fibre comes from the efficient frictional cohesion, and this becomes of little importance when the fabric is impregnated with varnish, etc.

Through the constant investigation of the current problems of the industry, the Shirley Institute is kept aware of any special needs in regard to staple and character of cottons. It can be said generally that there is an adequate supply of all types in demand and no need to stimulate the production of any particular type to meet a special demand. That need, however, might arise at any moment. If, for instance, the industry decided that a long, coarse cotton was best for mechanical fabrics—tyres, canvas, ropes, etc.—a large demand might arise that would strain the supply and upset the economic equilibrium of cotton growing — if such exists. The growers quickest to appreciate the changed position would reap a good harvest. As the problem of cotton character and value is simplified, to make it amenable to quantitative analysis, it is well to keep the judgment free to appreciate changing conditions of economic value.

With these introductory reservations, we may safely allow ourselves to discuss "spinning value," which so often seems to replace completely the ideas both of commercial value and real utility. It is generally a very good measure of both, and the judgment of character is greatly simplified by limiting it to the assessment of spinning value. This is itself determined almost entirely by the limit of fineness to which the cotton can be spun, with some qualitative deductions on the score of unlevelness, neppiness and cleanliness of the yarn. Breaks in spinning and in winding may affect the judgment, but, in the main, the limiting count or fineness for which a cotton is suitable is judged by the lea strength of the yarn. Here is an enormous simplification of the problem of cotton character—to reduce it to a lea test.

A laboratory assistant fastens the loose end of a cop of yarn to a reel, spins the swift till a gong rings, transfers the lea to the hooks of a machine and moves a switch. The load on the lea increases, a thread breaks, then more, others slip till the lea stretches too rapidly for the upper hook to keep pace, and the assistant notes the inclination of the pendulum. A merchant is arranging for the production of a line of shirts. He wants them to be as attractive as possible but also to avoid complaints of bad wear, and he certainly demands a profit. In one way or another, through the spinner, he decides what cotton will be used. Mr. C. studies the results on his pedigree plots and has to anticipate the merchant's choice from the lab. girl's notes. What is the connection? The connection is a chain of correlations, of which no link is perfect, but strong enough to bear the weight of judgment in most cases, to lift the quality and lower the price of our shirts. The links are appeal, utility, demand, spinners' judgment, behaviour in processing, lea tests on experimental spinning, growing costs. Though one rarely uses cotton in any way remotely resembling the conditions of the lea test, its result has quite a strong connection with all these links.

The lea test is, however, not the first line of evidence of the cotton breeder—that must be the easily measurable characters of the lint. Of these, the length is the most familiar, and it enters this chain of correlations as a reasonably strong link. On it depends most of the weight of judgment by which cotton growing, selling and manufacture are carried on. But more critical study shows that there are gaps in the links and the failure of prediction is too probable to rely on them for all the purposes of modern industry, especially for the development of large areas for growing cotton of controlled pedigree. Length is not all sufficient, and it is found to be correlated with other features that may be more directly the cause of differences of behaviour—in particular, with fineness. As the correlation is not perfect nor invariable, the more precise evaluation of cotton character demands the measurement of these other important features.

As higher correlations are demanded, their range must be restricted. It can hardly be expected that the same character or combination of features will affect in the same way all the aspects of value. The problem must be divided up and strong connections attempted between each pair of links in the above chain. The most direct connection would be between the Mendelian factors with which the geneticist works, and the price, for which he works; but Botany and Commerce are different species and this hybrid is not viable. The measurable characters of the lint must provide the common basis for evaluating cottons for any purpose.

A direct prediction of price from lint measurements would be most convenient, but there are factors of price that no physical instrument can measure. One must choose the form of behaviour most closely determinative of price and capable of objective observation. By common consent, spinning value is adopted for this purpose and is determined mainly by lea tests on experimental spinnings.

The problem of cotton evaluation is thus narrowed down to the numerical correlation between the results of lea tests and of hair measurements. As this discussion is intended to clarify the purpose of the investigation and the significance of the measurements, their technique will be dismissed by a reference to the efficient description by Underwood (*Journ. Text. Inst.*, 1935, **26**, pp. 309-335). From lea tests on spinnings of several counts, that count is determined at which the count-strength product is 2,000 for carded yarns, 2,250 for combed. The product drops by about 20 units for each unit increase of count, so the strength at any reasonable count may be predicted for yarns spun by the particular experimental method.

The lea strength represents about 70 per cent. of the aggregate strength of the 160 threads broken in skein form, but the ratio varies with the regularity of the yarn, and other features such as roughness. Breaks in winding and other processes are closely related to the low value "tail" of the single-thread strength distribution. The strength of fabrics with identical structure is quite closely related to lea strength. Above all, the spinner is accustomed to judge his yarn on this figure.

Yarn strength depends on two features: the irregularity that determines the thickness of the weak elements, and the cohesion that determines the strength of an element of given thickness. That cohesion depends on the frictional grip of the fibres and on their strength, to varying degree according to the hair properties and the thickness and twist of the yarn. The irregularity depends on the drafting quality of the cotton and on the method of spinning. There are various ways of spinning cotton: on ring frames or mule, with low or high draft of various systems; from single or double roving; with various draft combinations; with or without combing. The different treatments affect the relative importance of drafting quality and cohesion. The spinning test procedure is fairly representative, but when fundamental researches on drafting are complete, a more analytical evaluation of the spinning qualities of cotton may replace the direct trial.

Meanwhile the Standard Count may be taken as a sufficient measure of the spinning value for the next step in correlation with hair characters. The breeder need not concern himself with the wide fields of research hidden behind this figure—on spinning, testing and uses of cotton—but may be confident that they are not neglected and that no serious misconception would be allowed to arise from this simplification of the problem.

From the study of spinning, a considerable number of physical properties of the hairs may reasonably be expected to influence both drafting and cohesion—geometrical form and size, strength, extensibility, rigidity, friction, wax content and the variance of these properties between the hairs. Though all these may be directly the cause of variation in behaviour, no feature need be measured and included in a prediction formula unless its independent variations have significant effect. Not only the hair strength but even the specific strength is correlated with the fineness of the hair and so with the length. Much the same may be said of convolutions, wax content, rigidity, and the other physical properties. It cannot be said that they have no independent variance that would affect spinning as an independent determinant of behaviour, but the significance of any such effect has yet to be demonstrated. A higher correlation with the geometrical features and their variance has to be attained before we are justified in bringing in the variation of specific physical properties. These belong to a third stage of approximation, probably beyond that at which the Standard Count may be taken as a sufficient measure of value. In the meantime, they are not being ignored, but the breeder would not be advised to complicate his task by considering them at the moment.

The present position is, then, that the Standard Count has to be correlated with the geometrical form—length, breadth and thickness and its variations. Each of these features is expressed in a way specially suited to the problem, adapted to the form of the hair, its behaviour in spinning and its manner of growth.

The Effective Length of a cotton is a good approximation to the commercial estimate of staple length, and both are reasonably related to fibre control in drafting. Rollers are set at the best distance for controlling a certain length of fibre; a proportion of longer fibres must be ignored to deal most favourably with the bulk. Very short fibres are uncontrolled or " floating," and there is no point in adjusting the setting according to the length or amount of these. The cotton classer discards the short stuff, merely noting the quantity as an index of irregularity; trims the tuft, but ignores a proportion of the longest hairs in estimating the length. In the determination of Effective Length, the same thing is done in a simple objective manner. It may be defined as the upper quartile of the length distribution, ignoring hairs of less than half the effective length.

Longer hairs are generally finer, but the relation is not invariable, and it sometimes appears that long, coarse hairs and short fine ones show the effect of hairweight rather than length in their spinning value. The causal connection is obvious, for the number of hairs per section of yarn is inversely proportional to the hairweight per centimetre (H). The latter, in units of 10^{-8} gm./cm., may be expressed in the units of yarn count (N) from the formula $NH = 0{\cdot}5906 \times 10^{6}$. Thus, an American cotton with hairweight of 197 has a count of 3,000 and has some 100 hairs per section in 30's yarn; an Indian of hairweight 295 would have only 67 much stiffer hairs (neglecting the take-up due to twist).

Hairweight has therefore been included in all studies of cotton character, particularly of spinning value. Despite its obvious importance, the results of inclusion in formal correlations are rather disappointing. The reason is evident in the study of cottons from new growing fields, many of which have very low hairweight because the hairs are not properly thickened. The effect of this has no similarity to that of a difference in fineness of well-grown crops. A measure of " immaturity " must therefore be included.

The threefold correlation attained fairly high values with Standard Count (*vide* Underwood, *loc. cit.*), but study of the results suggests that the real determinant of behaviour is not the actual hairweight, but the intrinsic fineness after allowing for immaturity.

The test for immaturity (*Journal of the Textile Institute*, 1932, **23**, T.46), in effect, determines a frequency distribution, in three unequal intervals, of the degree of thickening, as shown by its effect on convolution after swelling in caustic soda. This comparative, " behaviouristic " test has been reduced to a more general quantity, giving it geometrical meaning and facilitating comparison with other measures of wall thickening. Earlier work has already been reported (Peirce and Lord, *E.C.G.C. Report*, 2nd Conference, 1934, pp. 223-239), and the full results will be published shortly. They provide a formula to calculate, from the Immaturity Test, the Maturity Ratio, the ratio of the area of wall section to the area of the circle with the same perimeter.

The hairweight corrected to a standard maturity ratio is called the Standard Hairweight, but there is some advantage in converting it into an inverse measure directly comparable with yarn count, namely, the Intrinsic Fineness, the equivalent count of 100 hairs. Spinning quality is more highly correlated with this quantity than with any other; and the residual effect of immaturity, when so isolated, is quite small. A complex of important characters may be associated with the fineness, of more influence than the amount of cellulose and the convolutions that vary with immaturity.

There are good reasons for believing that the intrinsic fineness is the most stable genetic character of lint. The immaturity is clearly the sport of soil and season; length is intermediate in its dependence on heredity and environment. Other determinants of the spinning value found on a breeder's experimental sample may be unstable and uncertain of reproduction on the large scale—variance of length and maturity, content of wax and other minor constituents, and more subtle features that may superimpose their effect on that of mere geometry, any effect due to rate of deposition, etc. As a measure of the quality of a variety, judged from a small experimental sample, the intrinsic fineness may even be better than the spinning test itself.

Though anomalies remain in the relation of spinning value to hair geometry that justify the further pursuit of the correlation and the continued routine use of spinning tests, the stress already appears to be spreading from this aspect of cotton character. Other characters need to be correlated with effective length, intrinsic fineness and degree of thickening; in the laboratory, the physical and chemical properties; in industry, the behaviour of cotton beyond the spinning frame and in different uses; in the field, the various factors of genetic constitution and of growth. The correlation of small samples with bulk crops is an assumption essential to the breeder's work and may be made more secure by suitable selection of samples and of measured characters. But cottons cannot be ranked in an absolute order of best to worst, valid for all uses and times. Measured characters are the raw material for judgment of the needs of industry and consumers.

Received July, 1937.

SOME REMINISCENCES OF WORK ON THE COTTON CROP

BY

H. C. SAMPSON, C.I.E., F.L.S.

I

PEOPLE say that as one gets older one is inclined to dwell more on the past, and this perhaps may be taken as my excuse for writing some of my experiences concerning cotton. The very fact of writing down the following notes has recalled to my mind many happenings which I had long since forgotten.

My first acquaintance with the cotton plant was in 1904, when I had charge of the trial introductions made by the Transvaal Department of Agriculture. These were American Upland, Egyptian and Sea Island varieties. They were being grown at experimental stations near Pretoria, on the Springbok Flats in the Waterberg District, and at Tzaneen in the Zoutpansberg District. Besides this, seed had been distributed to several settlers in the last-named district for trial. I have no very vivid recollection of these cottons except that neither the Egyptian nor the Sea Island varieties appeared to like their new home. The American cottons grew well and were quite healthy, but at Pretoria and in the Waterberg only a few bolls opened before the frosts killed the plants. My most vivid recollection is of the Zoutpansberg District, where I travelled round the country on horseback looking up the settlers who were trying these crops. Riding along deep and narrow native footpaths on a hot day, and mounted on a rather sluggish remount, which hailed originally from the Argentine, and without getting the sight of a settler's home, is my recollection of my first day. As the sun was setting I was completely lost, when I sighted a small group of what I took to be native huts. This turned out to be a Kaffir store which was run by a Swiss. I told him my dilemma, and was allowed to spend the night behind the counter of his store and to use some of his trade blankets for bedding. He laughed at my difficulty, and explained that all the Europeans in the district were known only by their native names—names which were generally more descriptive than complimentary—and he furnished me with those of the settlers whom I had to see. His main source of income

I gathered was in trading mealies with the natives, which he bought cheaply at harvest time and stored in an underground silo. These he resold to the natives before the next crop came in, when prices ruled high.

I renewed my acquaintance with cotton when I went to India in 1906. Travelling down to Madras through Dharwar and Hubli, one could not but be impressed with the carefully tilled fields and the serried ranks of closely spaced cotton, so different from the untidy appearance and rather sketchy cultivation to which I was accustomed in South Africa.

At the time that I joined the Madras Agricultural Department, in 1907, Mr. Charles Benson, who for many years had been Deputy Director of Land Records and Agriculture under the Board of Revenue, was about to retire, and he handed over charge to me of two agricultural stations where he was growing cotton. One of these was supposed to be a demonstration pumping station where an oil engine and pump had been installed to lift irrigation water from a well. The farm, if such it could be called, was situated on the banks of the Palar River, some twenty miles from Madras. It was a sandy waste overrun with prickly pear. Here, with the aid of prickly pear refuse, village sweepings and irrigation water, he had managed to grow a collection of perennial cottons. Besides Indian cottons, these included the then much advertised Caravonica cottons from Australia—Caravonica No. 1 and No. 2, and Caravonica Kidney, and several South American perennial cottons.

The other station was in the extreme south on the Tinnevelly black cotton soil, where the work was mainly confined to the two local cottons—*Gossypium herbaceum* and *G. arboreum* var. *neglectum*, and here subsequently I spent much of my time. Besides these two local cottons two introductions were being tried. One of these was a variety of *G. hirsutum* received from Afghanistan, and the other a variety of the same species obtained from Cambodia in French Indo-China. I was thus fortunate in having a large number of different cottons under observation. The perennial cottons at the first station were of little practical interest, as it was very evident that their cultivation was of no economic value. The Kidney cottons and Peruvian cottons from South America had no liking for the extreme tropical conditions of South India, nor had the Caravonica cottons, besides which these last were splitting into various forms, some growing to an immense height and carrying little or no crop, while others were so dwarf that their bolls trailed on the ground. As this station was quite untypical of the agriculture of the district, and as the cultivation of perennia cottons could serve no useful purpose, it was, on my recommendation, closed down. I was thus able to concentrate on the work in the Tinnevelly cotton area.

There was a vast difference between the two strains of *hirsutum* cotton which were being tried here. The Afghanistan *hirsutum*, coming as it did from a more temperate climate, had a smooth, hairless leaf; it was never healthy. The leaves turned red and curled up, ultimately shrivelling and falling off. The Cambodia cotton, on the other hand, which had been developed under climatic conditions closely resembling those of South India, remained healthy even under rain-fed conditions. I attributed this to its hairy leaf, which would have the effect of slowing down transpiration. Cambodia cotton now forms an appreciable part of the Madras cotton production and is a remarkable example of the value of seed introduction. The Agricultural Department, however, could claim little credit for the rapid spread of this exotic cotton. Mr. Benson had, I believe, given a small quantity of seed to two or three ryots to try. They were quick to see that this new cotton had possibilities, but they apparently realized that it was not likely to prove an economic crop when grown under rainfall conditions on black cotton soils. These ryots were the first to discover its possibilities when grown under irrigation from their wells—a practice which was occasionally adopted with their local cottons and which sometimes gave extraordinarily heavy yields. Such garden lands, as they are called, are extremely well farmed and maintained; they are heavily manured with what cattle manure is available, and this is supplemented by what is known as prickly pear earth—*i.e.*, the accumulation of fine dust and vegetable debris which is collected by the wind under the shelter of the prickly pear. The soils are deepened also by carting on to the fields large quantities of silt which annually accumulates in the irrigation tanks or reservoirs under which rice is grown. It was on these rich artificial soils that Cambodia found conditions which proved satisfactory for growth and cropping. It was a most valuable acquisition to the farming of such lands, since it usually required only two or three irrigations, and this enabled farmers to extend the area commanded by their wells. Subsequently, of course, the Agricultural Department by its work of selection has done much to improve the quality and cropping capacity of Cambodia cotton. It was, however, some years after its spread that this work could be undertaken, and it was impossible to do this on the Tinnevelly station, which, being a black cotton soil without facilities for irrigation, was quite unsuitable for such work.

Formerly the Tinnevelly cotton crop was a mixture of two cottons. There were "Uppam," a variety of *G. herbaceum,* and "Karunganni," a variety of *G. arboreum* var. *neglectum.* When I took over charge of the Tinnevelly cotton station, Benson had already separated out these two cottons and had not only made crosses of the two kinds, but had also pollinated flowers of each species with pollen from another plant of the same species. Thus the crops which I had under observation in 1907, besides the ordinary mixture of the two kinds, were comprised of:

Uppam × Karunganni	F.1 and F.2.
Karunganni × Uppam	F.1 and F.2.
Uppam × Uppam	F.1 and F.2.
Karunganni × Karunganni	F.1 and F.2.

It must be borne in mind that at that time one had very little literature to guide one in one's work. American literature on cotton only dealt with the New World cottons, and chiefly with Upland types, which require entirely different cultural conditions from the Indian or Old World cottons. Mendel's law had only recently been rediscovered. I had first heard of it from Mr. A. D. (now Sir Daniel) Hall, whom I met in the Transvaal when he visited South Africa with the British Association for the Advancement of Science in 1905. I immediately ordered Punnett's "Mendelism," the first edition of which had just been published. Another book of reference I had was De Vries' "Species and Varieties," and in 1908 I obtained Bowman's "Structure of the Cotton Fibre," which I found most useful.

At this time also, Gammie, who was the recognized authority on Indian cottons, held the view that these never crossed. This opinion I very soon had to modify as far as Tinnevelly was concerned. One could invariably find in ryots' fields, where the two species of cotton were grown in a mixture, plants similar to those produced by crossing the two species. Even the ryots recognized these as something different, giving them the name of "Vellai (white) Karunganni," owing to the fact that the short lint on the seed after it was ginned was white instead of being tinged with grey-brown as in the case of true Karunganni. They had also observed that the seed cotton from such plants was very difficult to gin. In those days many of them would reserve their own seed cotton for seed and gin this at home on the hand-gin or "churka." As this was ginned almost lock by lock, the output being only about 20 lb. a day, it gave ample opportunity to observe how seed cotton ginned. I subsequently made full use of this difficulty in ginning hybrids when examining selections in the field, and any plants where the lint was held very firmly to the seed were pulled out and treated as rogues. One year such rogues were specially prevalent, and I also found a natural cross between Cambodia and Karunganni in one of the station fields. This I put down to one of my assistants being a bee enthusiast and to the fact that he had kept a hive on the farm the previous season. Naturally I had in future to forbid this.

To return to the material with which I had to work, namely, the F.1s and F.2s of the crops raised by Benson. As one would expect, the F.1s of each lot were quite uniform in plant habit and lint characters. The F.2s of the hybrids gave a very varied assortment of plants; some were very dwarf with diminutive internodes, but giving a very fine staple; on this account a few of them were selected. Other plants were very tall and woody with a strong monopodial habit of branching, and carried practically no crop. Between these there were all sorts of variations. This behaviour may possibly help to explain why it is that Indian cottons which are or were almost invariably grown in mixture of more than one species have managed to maintain their specific identity. In a field-crop the dwarf plants would naturally be suppressed, while the giant vegetative plants being practically barren would tend to disappear. Selections from these hybrids were grown to the F.3 generation and after that they were abandoned. The dwarf plants were evidently recessive and gave no promise for selection, while the remaining selections showed a tendency to form giant vegetative plants which were of no value.

There was very little to choose between the plants of the F.2s of Uppam × Uppam. Several plants were marked and harvested separately to examine their lint characters, but these showed very little variation either in staple or in ginning outturn.

The F.2s of Karunganni × Karunganni (1905 pollination) were evidently heterozygous and gave rich material for selection. The F.2s of the same cross (1906 pollination) behaved quite differently and showed no variation. An explanation of this phenomenon has been suggested to me—namely, that by some extraordinary chance both parents happened to be homozygous. Several types were represented among the progeny of the 1905 pollination. Tall plants with long internodes and sympodial branching were a very tempting lot, and gave a cotton with a long, fine silky staple, infinitely better than any other Indian cotton which I have since seen. Long internodes appear to be correlated with a long staple and fine lint. The ginning outturn from selections of this type was never high, and it was impossible to get this above 28 to 29 per cent., while often it was as low as 22 per cent., the district average then being about 25 to 26 per cent. However, so great was the improvement in the lint of this type that I decided to multiply one of the selections and grew it on a seed-farm scale of a few acres. The results were disastrous. With its sympodial habit of branching it ripened its crop within a very short period, and in that particular season a spell of exceptionally hot, dry weather prevailed just when the bolls should have been swelling, there was heavy boll-shedding and a very poor crop of weak cotton. Thus all selections of this type were abandoned as being too risky to issue to cultivators. Attention was then concentrated on the progeny of two original selections. One of these was a short robust plant with a good framework of monopodial branches which carried their secondary sympodial branches. The original plant gave a ginning outturn of 38 per cent., but the lint was inclined to be harsh and less than ¾ inch staple. The chief point in its favour was its good pull, which indicated that it would spin well. After several years of selection it was possible to improve its fineness, twist, and staple, but only at the expense of the ginning outturn, which dropped to 33/34 per cent. However, this was about 8 to 9 per cent. higher than the district average, and the cotton was put out on to seed farms and immediately attracted attention. When in flower it was conspicuous among other cotton fields on account of its very large pale yellow flowers, which at about eight o'clock in the morning made a very striking sight. However, I was not altogether satisfied with this cotton, as I realized that with its secondary sympodial habit of branching it might suffer in an adverse season, though to a much lesser extent, in the same way as the selection already mentioned, which ended so disastrously. Nor was it suited to the south of the cotton tract, where the rainfall was always precarious and seldom exceeded more than 10 or 12 inches in the growing season. I had another strain among my selections which was strongly monopodial in habit. The lower main branches in their turn formed monopodials, while the upper branches from the main stem were also monopodial till quite close to the apex. The tertiary branches on the lower monopodials were sympodial, but never developed more than one or two flowers and bolls, and the same was true of the secondary sympodials higher up the plant. It was not a spectacular crop; the flowers were small and a deep yellow, and it never showed many flowers or open bolls at a time, but its habit gave it a prolonged ripening season with never any big strain on the plant's resources. It was thus able to mature its crop under conditions where a plant with a more sympodial habit would be bound to suffer. As one ryot remarked to me, in order to estimate the yield he had to sit down and study the plant, while with our other type one had only to walk through the crop to make an estimate of yield. In some ways it was not such a good strain in a good season, being more tedious to pick, and it was never possible to get the ginning outturn higher than 31 per cent. It proved, however, very attractive to the farmers of the precarious south.

I believe that I was the first to use cropping charts for my selections. These were only picking curves. Each plant was furnished with a large bag and picking took place every third day. Each picking was placed in a small bag with a date label, and this was placed in the large bag. At the end of the picking season these small lots were weighed and a graph prepared from the weights obtained. I also kept a diagram of each selection showing the branching and bolling habit of the type, so that one had this in one's mind when working through the progeny of a single plant selection.

It is possible that the methods employed in my cotton work may appear to be rather crude to the cotton specialist of today, but it must be borne in mind that at the time about which I have written, crop specialists had hardly been thought of. The work done was that of the district agricultural officer and the crop was only one of several which were receiving attention. The area which I had to cover extended to the southern half of the Madras Presidency, and there were under my charge stations where the following crops received major attention: groundnuts, rice, pepper, sugar cane, and cotton. Thus it was not possible to reside with the crops on which one was working and these could only be visited at intervals. It says much for the quality of the resident Indian staff of these stations that it was possible to achieve as much as one did.

This record of what was done and observed in respect of Indian cottons is written in the hope that it may prove of interest to those now connected with the work of cotton improvement in other parts of the Empire.

SEED DISINFECTION, WITH SPECIAL REFERENCE TO COTTON

BY

R. E. MASSEY

Late Government Botanist, Agricultural Research Service, Sudan.

It is a little over 200 years since Jethro Tull recorded the observations of farmers near Bristol, that seed wheat salvaged from sea water was free from bunt, but it is only recently that decisive progress has been made towards the successful protection of crops against seed-borne diseases by the treatment of seed prior to sowing.

Salt water steeps were employed until the nineteenth century, and although copper sulphate was known as an efficient fungicide in 1761, it did not come into use until a century later. Jensen's hot-water treatment was developed in 1887. Formaldehyde was employed in Germany in 1895, and in the U.S.A. in 1897. Copper sulphate and formaldehyde continued to be the most popular seed dressings until 1914, but in 1912 organic mercury compounds were introduced from Germany. Mercury chloride had been used before this date, but was not generally recommended.

The first organic mercury seed dressings were used in the form of steeps, the concentration of mercury salt in water ranging from 0·25 to 0·75 per cent. Powder or dust disinfectants came into prominence in 1915 following the employment of copper carbonate for cereal diseases, and their superiority over liquid preparations has led to their employment for the control of seed-borne diseases of crops in general.

Seed dressings designed specifically for cotton have been on the market for less than ten years, following experiments carried out on certain research stations in the U.S.A. Indeed, when the writer was faced with the task of disinfecting large quantities of cottonseed in the Sudan in 1928 there was no preparation available which could be used with confidence, and preliminary work was carried out with cresol disinfectants, and steeps containing chlorphenol mercury compounds, which in common with all immersion methods were exceedingly troublesome when carried out on a large scale.

Wet methods were soon replaced by dusts, of which Abavit

B, a proprietary preparation containing 8·2 per cent. mercury chloride and mercury iodide in talc, proved to be consistently the most efficient.

Now whilst there are at least a dozen well-defined diseases of cotton known to be transmitted by the seed, and whilst the improvement of stand and consequently yield obtained by the use of seed disinfectants is recognized, it is probable that the control of bacterial disease of cotton caused by *Bacterium malvacearum* E.F.S. ranks foremost whenever problems concerning the disinfection of cotton seed are discussed, and it is from this aspect that the writer wishes to review very briefly the results of several years' experiments in the Sudan.

Blackarm disease has been described in this journal, but it will be well to recall the method of transmission on and within the seed. The bacterium may lie dormant on the surface of the seed enclosed within fine fragments of infected tissue, or may adhere to the fuzz protected by a coating of slime formed during the destruction of the cellular tissues of the boll. In either case its resistant powers are very great, and seed has been found to be actively infected after two years' storage.

Infected dust may be derived from many sources. Probably the ginneries are the greatest offenders in this respect. Infection occurring within the boll may lie externally on the seed coats, or the bacterium may penetrate into the tissues of the embryo, in which case seed disinfection is of no avail. During the many trials carried out in the Sudan, extending over six years, complete control of infection was rarely obtained when seed was employed which had been picked from a plot heavily infected with blackarm disease. As might be expected, more successful control was obtained with fuzzy American seed than with Egyptian and Sea Island types, since it is difficult to ensure adherence of the disinfectant dust to the naked seed coat. This difficulty becomes more pronounced when large quantities of seed are involved, for the jolting during transport, and the handling by the cultivator dislodge many of the heavier particles of mercurial salts from the seed coat. It should be noted that the appearance of the seed is not always a satisfactory index to the amount of active principle present on the seed, for the filler may adhere better than the active principle.

The story of the relations existing between parasite and host during germination is a most interesting one. Under irrigation conditions there is abundant water from the time of the first watering to release the parasite from the slime in which it is embedded, and motility commences in a very short time, depending on the temperature, the age of the slime, and the degree of desiccation. Under tropical conditions there is vigorous motility after one hour, and this may be maintained for at least two days. Again depending largely on temperature, the seed swells, and within twelve hours the seed coat cracks, allowing access to the parasite. The first lesions most frequently appear on the edges of the cotyledons, which are folded like a parachute with the edges towards the micropylar end.

It is interesting to recall that when soil moisture is limited, infected seed may germinate without the seedling becoming infected, as the parasite either is not liberated or does not reach the cotyledons before they are pushed out of the soil. Also there is the fact that the life of the free parasite in the soil does not exceed seventy-two hours.

Two points become obvious when considering the composition of a seed disinfectant in the light of the above observations. Firstly, the adherence to the seed coat must be of a high order; and secondly, toxicity and solubility of the disinfectant must be such that a lethal film is present round the seed at the critical moment of attack, even under irrigation conditions, when the seed bed may be temporarily swamped.

Although this note is devoted primarily to one disease of the cotton plant, it seems certain that the same principles apply whenever seed disinfection is practised. The search for a suitable diluent or filler which would adhere satisfactorily to the fuzz and to the seed coat continued during two years. A large variety of clays, chalks, infusorial earth, bentonite, were examined, but nothing could be found markedly better than talc or French chalk. Lanolin, metallic resinates, resin, oils, and waxes were in turn added to the fillers, but it was at length apparent that the dust was mainly adherent to the seed coat in single layers, and that the heavy metallic compounds lay in discrete particles which were really little affected by any modification of the filler.

At one time it was thought, judging from the appearance of the treated seed, that bentonite was an improvement on French chalk, especially if the seed were damped by adding a little water to the mixing drum during the dusting operations, but field tests negatived this opinion; indeed, on the whole, rather less satisfactory control of disease was obtained when bentonite was employed.

The choice of the disinfecting agent was much more difficult, and the writer must gratefully acknowledge the assistance received from the chemists of the Dyestuffs Group, I.C.I., Manchester, in providing many complex mercurial compounds for trial. At the commencement of the work estimations of the lethal and the inhibiting dilutions of a few simple chemicals were made, using *B. malvacearum* E.F.S. as the test organism, and following closely the Rideal-Walker technique. For the present article it will suffice to say that a solution of mercuric chloride and mercuric iodide previously mixed in the ratio of 3 to 1 inhibited growth in a dilution of 1 in 2,000,000, and that no other chemical or combination of chemicals equalled this degree of toxicity.

When one came to the preparation of experimental dusts, it was decided to mix all mercurial compounds with the filler in such proportions as to give a content of 5·67 per cent. metallic mercury, thus bringing them into line with Abavit B. Non-mercurials were employed at a concentration of 10 per cent. As mentioned above, a standard grade of talc was eventually employed.

It is now necessary to describe the precautions that were taken in the field to ensure uniform results. Experience quickly showed that naturally infected seed was by far the best for testing purposes. In spite of efforts to standardize the cultures and the powdered diseased tissues used as inoculum, unsatisfactory results were always obtained with artificially infected seed.

Seed was hand-picked to ensure uniformity in size and freedom from trash. Not less than a thousand seeds were sown in any one test. All experiments were carried out with irrigation, and great care was taken in the preparation of the seed bed and the planting of the seed. The proportion of seed to disinfectant was of course constant throughout, and was based on field practice. One part of disinfectant was added to 150 parts of seed contained in a large tin, and the whole shaken for 45 seconds. A little water was then added and shaking resumed for another 45 seconds. The treated seed was handled as little as possible before and during sowing. The results were expressed as percentages of seedlings showing typical lesions on the cotyledons 16 to 21 days after sowing and watering. In the following tables are given typical results obtained during the later phases of the work, when operations had become stabilized. The figures represent the percentage of infection obtained with treated seed against percentage obtained in the untreated controls.

The controls vary widely, for in the later phases it was often difficult to obtain heavily infected seed. It is believed, however, that the degree of infection is sufficient to bring out the protective qualities of the compound under study.

Another factor introducing variability was the weather, for the ideal climatic condition for the development of the disease—*i.e.*, the rainy season—was not ideal for experimental work, since a shower of rain would give rise to secondary infection, and so ruin the test. In spite of these difficulties it is believed that the following broad conclusions may be drawn.

(*a*) Mercury is the only element presenting adequate toxicity, and a high proportion of mercury in any compound is desirable.

(*b*) Many organic mercury salts give satisfactory protection when employed in a sufficiently high concentration.

(*c*) Little connection can be traced between chemical constitution and efficiency as a seed dressing.

(*d*) Considering toxicity alone, and hence suitability for seed disinfection, complex organic compounds showed no superiority over certain inorganic mercury compounds.

(*e*) The introduction of iodine into the mercury compound increases efficiency where the control of *B. malvacearum* E.F.S. is concerned. Chlorides, acetates, and nitrates are not so satisfactory.

Finally, it must be mentioned that such obvious qualities as low toxicity of the active principle to the germinating seed and to the operator, and lack of corrosive properties to metal, etc., have been purposely omitted from the present article. Actually little action on the germinating seed was ever detected, though occasionally during germination tests on blotting-paper a transitory depressant effect was sometimes noticed.

As regards the danger to operators and cultivators, adequate precautions must be taken with all poisonous agricultural preparations. In the Sudan no serious case of mercurial poisoning was experienced during the four years that the writer was in charge of seed-dusting operations, though on occasions from 3,000 to 4,000 tons of seed were treated with a highly poisonous dust. We were, of course, fortunate in that the work could be carried out when the climate was extremely dry.

The writer would like to pay tribute to the help received from his colleagues and staff in the Section of Botany and Plant Pathology, Sudan Government.

TABLE I.

	Exp. 1.	*Exp.* 2.	*Exp.* 3.
Mercuric arsenite	1·3/31	3·6/55	0·2/35
„ arsenate	0·4/31	2·6/35	
„ chromate	0·5/31	2·7/55	0·2/35
„ chloride	5·8/60		
„ chloride+iodide	0·5/60	0·5/35	
„ chloride + chromate (equal parts) ..		12/60	
„ cyanide	1·4/31	0·4/35	
„ sulphocyanide	1·0/31	0·4/35	
Silver mercury iodide (2 per cent.)	1·2/55		
Silver mercury iodide (2 per cent.), mercury chloride (6·2 per cent.)	0·9/31	0·7/11	1·2/35
Copper mercury iodide (2 per cent.), mercury chloride (6·2 per cent.)	0·6/31	0·3/19	0·8/35
Zinc mercury cyanide	3·4/31		

Note.—

(*a*) Except where otherwise stated the concentration of mercury salt in the dust was calculated to give 5·67 per cent. metallic mercury.

(*b*) All figures refer to per cent. infected seedlings in treated/untreated control.

TABLE II.

	Exp. 1.	*Exp.* 2.	*Exp.* 3.	*Exp.* 4.
Phenyl mercury acetate	2·0/31	0·6/15	0·9/35	
„ „ chloride	0·1/55	0·2/55	0·9/55	
„ „ iodide	0·7/71	0·7/42		
„ „ nitrate..	2·9/15	6·2/55	7·3/66	
„ „ oleate	1·3/15	0·3/35		
Methyl mercury iodide	0·2/55			
Ethyl mercury iodide	0·3/55	0·2/35	0·4/42	4·7/71
„ „ phosphate	0·6/31	0·6/15	0·4/35	0·3/55
p-Butylphenol mercurichloride ..	0·5/31			
Tolyl mercury iodide	0·4/55	0·6/55	0·5/75	2·5/48
p-Cresol mercury chloride	1·8/55	0·2/55	0·6/42	4·5/75
„ „ iodide	0·9/66	1·9/55	3·0/75	5·7/71
Salicylic acid mercury chloride ..	3·4/66	5·9/55	3·2/75	6·4/48
„ „ „ iodide	1·4/66	2·5/75	5·6/66	0·0/55
o-Hydroxyphenol mercurichloride ..	5·5/15			
p-Hydroxyphenol mercurichloride ..	0·6/15			
o-Hydroxyphenol mercuri-iodide ..	0/15			
Hydroxymercurichlorphenol sulphate..	2/60	2·6/70		
„ acetate ..	3·3/60	4/70		
3-chloro-2-hydroxy-5-isoamyl phenyl mercurichloride	1·6/31			
3-chloro-2-hydroxy-5-isoamyl phenyl mercuri-acetate	7·2/31			
5-chloro-2-hydroxy-3-isopropyl phenyl mercurichloride	3·9/31			

Note.—In the case of organic mercury salts concentrations are based on mercury content, and all compounds were diluted with talc to give 5·67 per cent. metallic Hg in final product.

TABLE III.

	Exp. 1.	*Exp.* 2.
p-Nitrophenol	14/66	30/71
Sodium trichlorphenate	24/66	43/71
Chinosol (4 per cent.)	33/62	
Cetyl thiocyanate (4 per cent.)	50/62	
Proflavine sulphate (5 per cent.)	67/68	
Auramine (5 per cent.)	42/62	
α-Naphthol	41/66	12/51
β-Naphthol	61/66	36/51
Osmic acid (0·1 per cent.)	42/52	
Benzonaphthol	24/52	
Hexyl Resorcinol	23/52	
Naphthoquinoline	40/52	

Note.—All 10 per cent. concentrations in talc except where otherwise stated in brackets.

TABLE IV.

	Exp. 1.	*Exp.* 2.
Silver arsenite	18·2/28	17/45
„ chromate	15·7/28	14/45
Sodium silicofluoride (pure)	21/65	
Bismuth phenate	13·6/28	41/45
„ chromate	16·0/28	42/45
„ tribromphenate	20·5/28	36/45
„ salicylate	27·5/28	45/45
Zinc formaldehyde sulphoxylate	13·8/25	38/45
„ salicylate	16·3/28	37/45
„ resinate	18·5/28	30/45
„ chromate	17·3/28	37/45
Chromium fluoride	20/55	

Note.—All 10 per cent. concentrations in talc except where otherwise stated.

A NOTE ON A NEW METHOD OF CONTROL FOR INSECT PESTS OF THE COTTON PLANT

BY

T. G. MASON AND E. PHILLIS

Cotton Research Station, Trinidad.

THE relative toxicity of selenium to plants and to animals has in recent years aroused much interest, particularly in America, where certain soils have been found to contain appreciable quantities of this element.

It has been found (*cf.* Hurd-Karrer[1]) that selenium possesses the unique property of being more poisonous to animals than to plants. Plants to whose roots selenium was supplied were found to be toxic to pigs and rats. Hurd-Karrer also observed, that when selenium was supplied to plants infested with aphids, the insects left the plants. In a further paper,[2] moreover, it is recorded that selenium was *toxic* to aphids when the concentration exceeded 3 p.p.m., while with lower non-toxic concentration reproduction was inhibited.

These observations of Hurd-Karrer prompted us to try out the possibilities of using selenized cotton as a trap for stainers and bollworms. The high cost of selenium and the toxicity to man of plants grown on soils containing this element would, of course, restrict the method to trap crops. The two points on which information was sought were (1) the relative toxicity of selenium to the cotton plant and to its insect pests, and (2) whether plants fed with selenium were repellent to the insects. As our enquiry has now reached a stage at which the entomologist could, we think, be of great assistance, we have been led to publish this preliminary note on the results of our work.

We have grown cotton plants (Sea Island) in sand-culture and have used a nutrient solution to which selenium was added in the form of sodium selenate. In each of our experiments we have used five groups of plants: a control receiving no selenium, and the others receiving it at the rate of 5, 10, 20 and 50 p.p.m. respectively.

Growth was strongly depressed in the 50 group, but was only slightly affected in the 20 group. No effect was observed in the

10 and 5 groups. All groups flowered and ripened bolls. The symptoms of selenium poisoning were reddening of the veins, petioles and stems. There was also a tendency for the leaves to be chlorotic. During growth it was noticed that aphids were very prevalent on the controls, but few, and only adults, were seen on the selenized plants. Our observations do not support the conclusion that the plants were repellent, but indicate rather that infestation was maintained at a very low level by the death of adults and the inhibition of breeding.

Cotton stainers (*Dysdercus Howardi*, Ballou) of the fourth and fifth nymphal stages were fed on green bolls. Within a period of three weeks all the insects on the 10, 20 and 50 groups were dead, while 60 per cent. of the 5 groups were also dead. In the control there were no casualties. Copulation took place in all groups except the 50, but eggs were not seen in the 10 and 20 groups. Thus bolls can be rendered poisonous to stainers by means of selenium supplied to the roots.

In the second experiment nymphs of different ages were fed on seed from the 20 group. It was found that as development proceeds the stainer becomes more resistant to selenium poisoning.

In the third experiment selenized cotton plants were grown in sand-culture on a platform adjoining a field of cotton. When the field plants were cut down and burnt the stainers crowded on to the plants on the platform, where they died. The mortality was astonishing.

Thus selenized cotton plants are not repellent. Whether they are as attractive as normal plants remains to be ascertained.

The results of our experiments with the pink bollworm are less conclusive owing to the difficulty found in breeding them in captivity. The moths do not appear to be repelled by the selenized plants, for oviposition occurred indiscriminately on control and selenized plants. Inspection of plants exposed to bollworm attack showed 39 per cent. damaged loculi in the control, 16 per cent. in the 5 group, 7 per cent. in the 10 group, 7 per cent. in the 20, and 4 per cent. in the 50 group. There seems to be considerable mortality in the selenized bolls.

LITERATURE CITED

1. Hurd-Karrer, A. M. "Selenium Absorption by Plants, and their Resulting Toxicity to Animals." *Smithsonian Report*, 289-301, 1935.

2. Hurd-Karrer, A. M., and Poos, F. W. "Toxicity of Selenium-containing Plants to Aphids." *Science*, Vol. 84, No. 2176, p. 252.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

The new cotton season has certainly made a most extraordinary start with the first American Bureau, showing what may fairly be described as record figures. The July estimate of the acreage planted was rather less than had been expected, with a figure of 34,192,000 acres " planted and in cultivation as at July 1," an increase of only 10·4 per cent. on last year's final figures, as shown in the first table. But even then it was evident that weather conditions for the early stages of the crop had been unusually favourable, and when these conditions continued without a break throughout July and into early August it was obvious that the figures of the August Bureau would be high. The actual figures, however, were higher than almost anyone had expected, for the Condition was given as 81·3 per cent. as compared with the previous highest (since the present series of Bureau dates was inaugurated in 1924) of 74·9 per cent. in 1933. Before 1924 the date of this report was as at July 25, when, of course, the Condition would be rather higher, but even so we have to go back to 1911 for a higher figure when the Condition as at July 25 was given as 89·1 per cent., and it has never touched 80 per cent. since then.

The result was an average yield of 223·3 lbs. per acre, which is unquestionably a record since 1915. Before that date no yield estimates at all were published until December, but it may be noted that it is actually higher than the highest *final* yield ever known, which was 223·1 lbs. in 1898, and that was when boll weevil had hardly begun. The result was an indicated crop of 15,593,000 bales.

In September the crop figure was raised still further to 16,098,000 bales, with an average yield of 228·5 lbs. per acre!

The new season therefore starts under conditions dramatically different from those of the last few years. Since 1929 the Government have striven by one measure of control after another to restrict the production of cotton, but they only really succeeded in 1934 when drought drastically reduced the yield per acre. This year, with only the vestiges of acreage control surviving under the Soil Conservation Act, and the Government practically out of the market with their Pool holdings reduced to an almost negligible figure, Nature has again taken charge of the situation and looks like producing a bumper crop, though still, of course, below the great record of 17,755,000 bales in 1926; but that was on an acreage of 44,608,000. But the mere prospect of such a crop and the consequent fall of New York prices to within sight of 10 cents had already, even before the Bureau, produced renewed agitation for a crop loan this season. Roosevelt, however, was definitely against any form of crop subsidy without the re-introduction of crop control, so that the stage was set for another struggle over the whole question of crop restriction. The result was the announcement on August 30 of a loan of 9 cents on middling $\frac{7}{8}$ inch staple (or less for lower qualities) and a subsidy to bring the growers' price up to 12 cents, but not payable till next year and only if the grower has conformed with the Government's crop restrictions for 1938, which are to be settled by Congress next session.

At the same time, as will be seen from our second table, the Egyptian crop has started this season with very high possibilities. The increase of 15·3 per cent. in the acreage to 1,978,151 feddans is still short of the record of 2,082,420 in 1930, but an examination of the details by varieties shows that the great bulk of the acreage is in the heavier yielding varieties, especially Giza 7 and Uppers, and as the average yield of the Egyptian crop has been rising all round in recent years there is every reason to expect another record Egyptian crop this year. Even based on last year's average yields by varieties the total on this acreage would be about 10,300,000 kantars. The first Government estimate, however, which is not issued until October, will not be available in time for this issue.

As to other Outside Growths the major factor is of course always the Indian crop, which, as will be seen from our third table, was a new record last year, but as that was achieved on an acreage far short of the record of 28,403,000 acres in 1925, there is no reason why it should not be maintained this year. It only remains to add that already the prospects in China, Russia and Brazil, the three other largest crops, are indicating further increases, so that the world's total crops this year may easily exceed 36 million bales excluding linters. If all these prospects are realized, 10 cents may come to look a high price for cotton.

To return to the Indian crop on the question of quality, the figures of the allocation between long and short staple given in this table do not, of course, tally with those given in the table in the July issue, because in this case we endeavour to give effect to the more detailed allocation of the Indian Central Cotton Committee, which on the whole means a nett transfer from long to short staple; but in spite of this, the fact remains that the long-staple crop is a steadily increasing proportion of the whole and is this year exactly one-third of the total, which means over 2 million bales of cotton, equal to the ordinary run of American.

Our next table of the American Carryover cannot be quite completed until the Federation statistics of Mill Stocks outside of the U.S.A. are available early in September. We hope to have these figures in time for inclusion in the table, but it is already clear that making an estimate of these mill stocks the total will be about 6,250,000 bales against 7,005,000 a year ago. This may be compared with Garside's figure of 6,213,000 bales against 6,962,000 last year and the New Orleans Cotton Exchange figure of 5,740,000 bales against 6,732,000. All these figures are excluding linters. These figures of the reduction of the Carryover are fairly well in line with the known figures of the crop and the estimates of world's consumption.

Our next table, which gives the World's Consumption of All Kinds of Cotton, must also of course await the Federation statistics for its completion, but in the meantime it may be noted that Garside's estimate of the world's consumption for the season is 13,087,000 bales of American and 17,800,000 of Outside Growths, or a total of 30,887,000 bales of All Kinds, while the New Orleans Cotton Exchange estimate for American alone is 13,253,000 bales.

As we have pointed out several times during the season the world's consumption of American cotton has been made up of an enormously increased consumption in the United States itself, set off by a smaller reduction in other countries. The detailed figures for the United States are given in the next table, which shows that the record-breaking figures of last March were not quite maintained during the rest of the season, but the season's total of 7,944,803 bales of All Kinds is, of course, a new record by a very long way, the previous highest figure having been 7,189,585 bales in 1926-27.

The two remaining tables deal with prices, and it will be seen that the course of prices of the principal crops since this table last appeared has been very definitely downwards. So far as American is concerned that was almost entirely due to the improving crop prospects, which carried both New York and Liverpool to a new low level for the season on the last market day of July. After the August Bureau they of course went still lower, and the first effect of the loan announcement was again bearish, but the September Bureau caused only a slight further decline.

As to Egyptian prices, as the table gives Liverpool quotations we must now take account of the fact that the Sakel contract went out with September, but our futures quotations in this table were never for the actual nearest month but for the nearest really active month, which is sometimes two or three months ahead. While therefore in May we were using July, in June we transfer to October, and as there was no October contract for Sakel we have changed that quotation to Giza 7 from June onwards. The trouble with this system, however, is that in recent months the manipulation to which all sections of the Egyptian market have been so much exposed has mostly affected the near month which, especially in the case of Uppers recently, often moves in a totally different way from what may be called the more genuine quotations of a few months later. For some time, for example, near month Uppers has been substantially higher than Giza 7 or even than Sakel, which, of course, is absurd, but this is not shown by our figures because they are for October.

But this produces a further complication when we come to deal with spot prices in the next table because spot prices are practically synonymous with the near month quotations for futures, so that the spot price of Uppers is distorted by the abnormal position of the near month. This, of course, does not apply to the spot prices of other growths where there are no futures markets. The official season's average spot prices for all varieties are now available and we have inserted them for 1936-37, and it will be seen that the effect of the appreciation of American was as usual to reduce the relative prices of other varieties, except Tanguis, Uppers and Sakel.

P.S. 11.9.37.—The Federation figures have just come in, and the calculation of complete figures is subject to the usual difficulty owing to the absence of returns from Russia, Italy, Spain, and now China. Making the best of what information is available for Italy and Spain, where the Federation do not even attempt estimates, it appears that while the season's total for American is 13,346,000 against Garside's 13,087,000, the Federation total for Outside Growths is only 16,308,000 bales against Garside's 17,800,000.

The Federation Mill Stocks outside of the U.S.A. are considerably larger than we expected, and the World's Carryover of American cotton works out at 6,268,000 bales.

AMERICAN CROP (EXCLUDING LINTERS).

	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.
Acreage planted (000's)	39,110	36,494	40,248	27,860	27,888	30,960
Acreage harvested ...	38,704	35,891	29,383*	26,866	27,335	30,028
Crop (running bales)...	16,629	12,710	12,664	9,472	10,420	12,142
Yield per acre (lbs.) ...	211·5	173·5	212·7	171·6	186·3	197·9
Season's average spot price (Liverpool—pence per lb.) ...	4·82	5·62	6·02	6·93	6·52	7·12

Progress of the Season 1937–38.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	34,192	34,192				
Acreage harvested ...	33,429	33,736				
Crop (500 lb. bales) ...	15,593	16,098				
Yield per acre (lbs.)...	223·3	228·5				

---

* Less 10,396,000 acres special abandonment.

EGYPTIAN AREA AND CROP BY VARIETIES.

(The Crop Estimates Exclude Scarto.) 000's Omitted.

	1935.			1936.			1937.
	Area: Feddans	*Crop: Kantars*	*Average Yield*	*Area: Feddans*	*Crop: Kantars*	*Average Yield*	*Area: Feddans*
Long Staple:							
Sakel	297	901	3·03	162	520	3·21	161
Maarad	82	362	4·43	72	289	4·04	81
Giza 7	270	1,267	4·70	407	1,888	4·64	520
Sakha 4	28	118	4·28	42	158	3·78	41
Casouli	3	7	2·97	—	Giza 26	—	2
Group Total	679	2,656	3·91	683	2,856	4·18	805
Per Cent. of Total ...	40·7	31·8	—	39·8	32·0	—	*40·7*
Medium:							
Nahda	5	27	5·16	—	—	—	—
Fouadi	32	138	4·38	19	79	4·20	11
Giza 12	—	—	—	6	35	6·00	16
Giza 3	10	30	2·93	9	28	3·12	3
Others	5	13	2·80	1	5	3·51	—
Group Total	52	208	4·03	35	147	4·20	30
Per Cent. of Total ...	3·1	2·5	—	2·0	1·7	—	*1·5*
Short:							
Ashmouni and Zagora ...	938	5,478	5·84	998	5,901	5·91	1143
Per Cent. of Total ...	56·2	65·7	—	58·2	66·3	—	*57·8*
Grand Total	1,669	8,343	5·00	1,716	8,904	5·19	1,978
Per Cent. Change in Acreage	*3·6*	—	—	*+2·8*	—	—	*+15·3*
Lower Egypt	1,113	—	—	1,127	—	—	1,266
Upper Egypt	556	—	—	589	—	—	712
Per Cent. of Total ...	*33·3*	—	—	*34·3*	—	—	*36·0*

INDIAN CROP.

(000's *Omitted.*)

	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.
Area (acres)	23,722	22,483	24,137	23,972	25,999	25,219
Crop (Government estimate) 400-lb. bales	4,007	4,656	5,108	4,857	5,933	6,307
Average yield per acre (lbs.)	68	83	85	81	91	100
Staple ⅞ and above (bales)	1,306	1,347	1,365	1,255	1,954	2,102
Per Cent. of Total ...	*32·6*	*28·9*	*26·7*	*25·8*	*32·9*	*33·3*
Staple below ⅞ (bales) ...	2,701	3,310	3,743	3,603	3,979	4,205
Per Cent. of Total ...	*67·4*	*71·1*	*73·3*	*74·2*	*67·1*	*67·7*
Commercial Crop :						
Net exports (bales) ...	1,582	2,868	3,406	3,115	3,826	—
Mill consumption ...	2,346	2,361	2,336	2,612	2,678	—
Domestic consumption ...	750	750	750	750	750	—
Total	4,678	5,979	6,492	6,477	7,254	—
Per cent. on Government estimate	+16·7	+28·4	+27·1	+33·3	+22·3	—
Season's average spot price (Liverpool*—pence per lb.)	4·32	4·84	4·52	5·24	5·21	5·29
Per cent. on American ...	89·6	86·1	75·1	75·6	79·9	74·3
* No. 1 Fine Oomra						

WORLD'S CARRYOVER OF *AMERICAN* COTTON.

(Running Bales 000's, excluding Linters in U.S.A.)

End of—	*Stock and Afloat.*			*U.S.A.*		*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*	*Elsewhere in U.S.A.**
	U.K.	*Continent.*	*Orient.*	*Mill Stocks.*	*Public Warehouses.*				
1930, July ...	304	544	143	1,048	2,803	4,842	937	6,249	470
1931, January ...	644	1,198	343	1,523	7,895	11,603	907	12,510	—
July ...	436	766	401	922	4,491	7,016	950	8,816	850
1932, January ...	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July ...	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January ...	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July ...	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
1934, January ...	617	1,367	752	1,557	9,469	13,762	1,320	15,082	—
July ...	405	734	590	1,172	5,526	8,427	1,132	10,509	950
1935, January ...	397	640	768	1,148	8,912	11,865	1,060	12,925	—
July ...	201	395	315	749	5,708	7,368	955	9,003	680
1936, January ...	493	614	565	1,405	7,823	10,900	858	11,758	—
February	463	637	457	1,372	7,223	10,152	—	—	—
March ...	420	665	405	1,302	6,543	9,335	—	—	—
April ...	385	593	371	1,155	5,992	8,496	—	—	—
May ...	362	523	323	1,053	5,205	7,468	—	—	—
June ...	356	471	251	944	4,498	6,520	—	—	—
July ...	321	359	195	855	3,907	5,637	793	7,005	575
August ...	280	291	172	710	4,304	5,757	—	—	—
September	322	430	254	811	6,773	8,590	—	—	—
October ...	382	519	352	1,367	8,003	10,623	—	—	—
November	381	600	444	1,760	8,395	11,580	—	—	—
December	460	613	470	1,971	7,768	11,282	—	—	—
1937, January ...	493	647	460	2,034	6,761	10,395	—	—	—
February	476	613	499	2,022	5,944	9,554	—	—	—
March ...	520	561	606	2,034	5,013	8,734	—	—	—
April ...	470	524	609	1,935	4,186	7,724	—	—	—
May ...	439	466	603	1,758	3,559	6,825	—	—	—
June ...	365	381	439	1,484	3,058	5,727	—	—	—
July ...	321	304	350	1,223	2,774	4,972	896	6,268	400
August ...	277	287	277	—	—	—	—	—	—

* Included in total

WORLD'S CONSUMPTION OF COTTON.

(From the Statistics of the International Federation.)

(*Running Bales, 000's—Excluding Linters.*)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*Others.*	*Totals.*
American.	1931–32	1,342	3,343	4,744	2,636	251	12,316
	1932–33	1,400	3,836	6,004	2,655	276	14,171
	1933–34	1,461	3,976	5,553	2,238	306	13,534
	1934–35	1,049	2,782	5,241	1,997	285	11,354
	1935–36	1,378	3,033	6,220	1,793	311	12,735
	1936–37	1,262	2,523	7,765	1,458	338	13,346
Indian.	1931–32	183	727	21	3,834	23	4,788
	1932–33	126	600	16	3,455	23	4,220
	1933-34	234	844	14	3,638	42	4,772
	1934–35	342	889	22	4,501	18	5,772
	1935–36	386	782	55	4,352	23	5,598
	1936–37	428	849	77	4,612	16	5,982
Egyptian.	1931–32	301	480	53	120	26	980
	1932–33	301	442	58	104	29	934
	1933–34	366	515	69	119	39	1,108
	1934–35	362	552	55	185	41	1,195
	1935–36	356	558	45	164	60	1,183
	1936–37	390	550	52	197	89	1,278
Sundries.	1931–32	560	1,730	26	1,133	786	4,235
	1932–33	421	1,797	32	1,922	856	5,028
	1933–34	409	2,137	33	2,154	964	5,697
	1934–35	754	3,099	19	2,456	1,152	7,480
	1935–36	613	3,264	19	2,694	1,288	7,878
	1936–37	771	3,611	41	3,245	1,380	9,048
All kinds.	1931–32	2,386	6,280	4,844	7,723	1,086	22,319
	1932–33	2,248	6,675	6,110	8,136	1,184	24,353
	1933–34	2,470	7,472	5,669	8,149	1,351	25,111
	1934–35	2,507	7,322	5,337	9,139	1,496	25,801
	1935–36	2,733	7,637	6,339	9,003	1,682	27,394
	1936–37	2,851	7,533	7,935	9,512	1,823	29,654

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

1935–36.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
February ...	516·6	25·8	504·2	1·9	5·6	5·0	53·6
March ...	548·9	25·0	536·9	1·8	5·0	5·3	60·8
April ...	576·8	26·5	562·7	1·7	5·8	6·6	61·4
May ...	530·8	25·3	518·3	1·4	5·2	5·9	64·7
June ...	556·3	25·3	542·8	1·4	5·3	6·9	64·0
July ...	603·2	26·2	588·3	1·8	6·1	7·0	70·2
*Season's total**	6351·2	—	6198·5	21·4	67·0	64·3	734·2
1936–37.							
August ...	574·3	27·3	560·3	1·7	5·6	6·7	65·4
September ...	629·7	29·0	613·7	1·7	5·9	8·5	67·9
October ...	646·5	29·7	630·9	1·8	6·0	7·8	72·5
November ...	626·7	30·6	612·0	1·9	5·5	7·3	63·8
December ...	692·9	33·0	676·8	2·0	6·4	7·7	61·9
January ...	678·1	32·7	662·5	1·8	6·5	7·2	63·4
February ...	664·4	33·6	649·0	1·8	6·2	7·5	63·6
March ...	779·3	33·9	759·8	2·2	7·6	9·7	74·3
April ...	718·9	32·7	700·7	1·9	7·8	8·6	72·8
May ...	669·5	32·3	652·9	1·5	6·8	8·3	70·5
June ...	681·4	31·0	662·1	1·5	6·8	11·0	66·6
July ...	583·1	27·8	569·8	1·0	5·9	12·4	74·5
	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HIGHEST AND LOWEST FUTURES PRICES.

	American.				*Egyptian (Liverpool).*			
1935-36.	*New York.*		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
February	10·99	10·63	5·87	5·62	8·81	8·29	7·14	6·84
March ...	11·34	10.59	6·08	5·66	8·76	8·34	7·20	6·90
April ...	11·31	10·80	6·11	5·83	8·72	8·45	7·18	6·94
May ...	11·58	11·02	6·13	5·93	8·68	8·48	7·30	6·95
June ...	11·79	10·60	6·34	5·79	9·20	8·44	7·45	6·84
July ...	*12·78*	11·51	*6·84*	6·23	*11·04*	9·14	*7·92*	7·35
1936-37.								
August ...	12·16	*11·30*	6·53	*6·10*	10·79	9·96	7·49	6·99
September	12·30	11·50	6·68	6·13	10·18	*9·67*	7·32	*6·91*
October ...	12·21	11·51	6·78	6·51	10·80	9·93	7·45	7·14
November	11·92	11·51	6·75	6·46	10·91	9·93	7·36	7·17
December	12·54	11·85	6·89	6·54	10·24	9·80	7·77	7·31
January ...	12·85	12·24	7·15	6·73	10·15	9·83	8·05	7·61
February	12·77	12·36	7·16	6·89	10·15	9·49	8·40	7·83
March ...	*14·70*	12·79	*7·96*	7·18	*12·50*	9·89	*9·73*	8·39
April ...	14·53	12·76	7·94	7·00	12·48	10·60	9·72	8·75
May ...	13·19	12·58	7·33	6·94	11·15	10·36	9·40	8·83
June ...	12·75	11·79	7·14	6·62	9·44*	8·68*	8·48	7·91
July ...	12·58	10·75	6·92	5·93	8·84	7·90	8·42	7·46
1937-38.								
August ...	11·01	9·15	6·06	5·28	7·96	7·35	7·57	6·63

Maximum and minimum each season in italics.
* Quotation changed to Giza 7.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1935-36.	*American (Middling). Pence per lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil.*		*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
				Pernam (Fair).	*San Paulo (Fair).*				
February	6·04	82·3	100·8	99·2	101·7	111·6	121·5	116·9	149·5
March ...	6·44	78·6	100·0	96·9	100·8	110·1	119·4	114·4	142·9
April ...	6·62	76·6	100·0	97·0	100·8	109·8	118·9	112·5	138·2
May ...	6·64	72·6	99·2	94·7	99·2	106·0	118·1	113·6	130·6
June ...	7·18	73·8	98·6	93·0	95·8	104·2	115·3	112·3	128·8
July ...	7·10	79·6	97·9	92·3	94·4	103·5	115·5	126·1	158·2
Season's average	6·52	79·9	100·2	96·8	99·7	108·9	116·6	114·7	141·4
1936-37.									
August ...	6·70	74·0	97·0	91·8	94·0	104·5	117·9	117·3	153·4
September	6·73	76·1	99·3	94·1	96·3	106·7	117·8	109·5	150·8
October ...	6·81	74·0	100·3	95·2	97·4	106·5	123·0	106·5	167·6
November	6·72	75·0	98·8	95·1	97·3	107·7	124·1	109·8	170·4
December	7·10	75·4	98·6	94·4	96·5	107·0	125·4	110·3	146·5
January ...	7·34	73·3	98·6	94·6	96·6	106·8	130·7	111·9	139·6
February	7·41	71·0	97·6	92·8	96·2	106·3	130·0	114·3	137·8
March ...	7·95	73·2	98·7	94·3	97·5	106·9	125·8	122·1	159·5
April ...	7·22	74·2	98·6	93·8	97·2	107·6	128·4	128·1	155·1
May ...	7·36	74·3	98·6	93·9	97·3	107·5	127·9	133·0	157·1
June ...	6·95	77·3	98·6	93·5	97·1	107·2	125·9	137·8	144·6
July ...	6·12	75·5	98·0	93·1	97·2	108·7	128·3	142·2	147·9
Season's average	7·12	74·3	98·5	93·7	96·5	106·6	124·3	118·8	152·0
1937-38.									
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

564. THE INDIAN COTTON SITUATION, 1929-35. (*Int. Rev. Agr.*, **27**, 1936, T405. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 411.) Deals with the geographical distribution of the cotton plant throughout India, the soils, methods of cultivation, and the systems of irrigation.

565. IMPROVEMENT OF COTTON IN INDIA. (Ind. Cent. Cott. Comm., 1937.) Successful attempts have been made by the Committee to build up a system for the distribution of pure seed throughout the country. Seventeen seed extension schemes have been financed, and these are briefly discussed; funds for a further scheme have been sanctioned. In addition, a considerable quantity of improved seed mixed with local seed in different proportions is being sown by cultivators outside the areas covered by the various seed distribution and extension schemes. As a result of the pure seed being mixed with local seed year after year, there is a general improvement in the quality of the cotton in these areas.

566. A GUIDE TO INDIAN COTTONS. (Pubd. Ind. Cent. Cott. Comm., 1937. Price 6 annas.) This is a joint publication of the East India Cotton Association and the Indian Central Cotton Committee. The characteristics, trade names, and districts where produced are given for the various types of cotton included under the main headings of Bengals, Broach, Oomras, and Southerns. A table of the staple length, blowroom loss, and spinning performance of the different strains under average mill conditions is given at the end, and the pamphlet should prove of interest and use to consumers of Indian cottons in that country and abroad.

567. SPINNING TEST REPORTS ON INDIAN COTTONS, 1936-37. By N. Ahmad. (*Tech. Circs.*, Nos. 281-293, 295-298, 1936-37. Ind. Cent. Cott. Comm.) The circulars contain the grader's report and spinning test results for Farm Westerns, Broach, Bailhongal, Hubli Kumpta, Surat, Kampala, Jinja, African Busoga, and Jagadia cottons, and the report of the Standards Committee on Surat, Jagadia, Broach, Muttia, Nanded, Navsari, Punjab-American, and Kadi-Viramgam cottons for the 1936-37 season.

568. FURTHER TESTS ON INDIAN COTTONS WITH DIFFERENT SYSTEMS OF HIGH DRAFT SPINNING. By R. P. Richardson and N. Ahmad. (*Tech. Bull. Ser. A. No.* 37. Ind. Cent. Cott. Comm., 1937.) This report contains the results of spinning tests carried out with nine different systems of spinning (the names of which are not disclosed) on the three Indian cottons: Superfine Oomra, Punjab-American 4F, and Cambodia Co. 2, and their mixtures in even proportions.

569. SCIENCE AND PRACTICE OF AGRICULTURE IN INDIA. By Rao Bahadur B. Visva Nath. (*Madras Agr. J.*, xxv., **5**, 1937, p. 160.) A review of the changes that are coming over agricultural methods and points of view as the result of recent studies of the following: soils, soil cultivation, soil base exchange and related phenomena, fertilizers and manures, the nitrogen cycle, the problem of organic matter and manure supply, and the problems of food and nutrition.

570. ON AN ATTEMPT TO USE HAND-SPINNING FOR TESTING QUALITY IN COTTON. By J. B. Hutchinson and V. G. Panse. (*Agr. and Livestock in India*, vii., **3**, 1937, p. 339.) Samples of cotton were hand-spun on the *takli* (a thin iron rod about 6 inches long with one end pointed and hooked) and the *charka* (Indian spinning wheel), and the count and strength of the yarns estimated. The results obtained were compared with those from spinning tests carried out at the Technological Laboratory. There was no agreement between the data for hand- and machine-spinning, and it is concluded that hand-spinning is of no value in estimating the quality of cotton for mill use.

571. LIST OF COTTON-PRESSING FACTORIES, WITH NAMES OF OWNERS AND PARTICULARS OF MARKS ALLOTTED TO THEM IN THE DIFFERENT PROVINCES OF BRITISH INDIA AND CERTAIN INDIAN STATES, FOR THE SEASON 1936-37. (No. 3082. Obtainable: Manager of Publications, Delhi. Price, As. 12 or 1s. 3d.)

572. ON THE CORRELATION OF WEATHER CONDITIONS AND YIELD OF KUMPTA COTTON, DHARWAR DISTRICT. By S. Ramakrishnan. (*Sankhya*, Vol. III., Pt. 1, 1937, p. 59.) Official estimates of the "Condition Figure" for Kumpta cotton in Dharwar district have been studied in relation to monthly average rainfall and monthly average maximum temperature for the twenty-seven years 1905-6 to 1932-33. The secular trend was eliminated by fitting polynomials in time of the third degree by the method developed by R. A. Fisher. Significant correlations with "Condition Figure" were found for August rainfall (+0·44), September rainfall (+0·43) and January maximum temperature (−0·51). Using these three factors the coefficient of multiple correlation was 0·789, which was definitely significant. The "Condition Figure" can therefore be forecast with considerable confidence by the end of January—that is, at least two months before the harvest season. In five years out of twenty-seven there were large deviations (exceeding twice the standard error) from forecast values. In two out of these five years the difference was probably due to the attack of pests, and in one year to abnormal weather factors not included in the regression formula. For a good harvest rainfall should be adequate in August and September, and temperature low in the month of January.

573. HYDERABAD COTTON. (*Text. Wkly.*, xix., **483**, 1937, p. 710.) An interesting survey of cotton production in Hyderabad, the largest Indian State, has recently been issued. There are 3,500,000 acres under cotton in the State, nearly 14 per cent. of the total area under cotton in India. One of the finest of the Indian indigenous varieties, Hyderabad Gaorani, is grown on over 900,000 acres annually. The total production amounts to about 480,000 bales of 400 lb. annually, at present equal in value to over £3,000,000. In recent years research work on cotton pests and diseases, improvement of varieties, and new sites for cultivation, has been carried out on a large scale with the support of the Government. Two improved strains of Hyderabad Gaorani have been produced which are heavier yielding than the existing trade variety, and it is estimated that by growing these new strains the cultivator stands to gain an additional income of 4s. 6d. per acre.

574. PUNJAB: *Cotton Cultivation*, 1935-36. (*Rpt. of Operns. of Dpt. of Agr.*, 1936.) A record area of 2,802,747 acres was planted to cotton, of which 1,305,457 acres were under Punjab-American and 1,497,290 acres under Desi cotton. This season 50 per cent. of the area under Desi cottons represented improved varieties. A considerable acreage was planted with 43F and Mollisoni 39, strains which were approved for general distribution last year. A new Jubilee cotton—a cross of Mollisoni 15 with Million Dollar—is under trial and appears promising.

Varietal, hybridization, irrigation, and cultural experiments were continued.

The chief cotton pests and diseases encountered during the year were black-headed crickets, grasshoppers, semiloopers (*Tarache notabilis* Wlk.), hairy caterpillars (*Euproctis* sp.), thrips, pink bollworm, spotted bollworm, white-fly, and the cotton root rot disease. The major part of the cost of the investigations that are being carried out on these pests and diseases is borne by the Indian Central Cotton Committee.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

575. The following reports have recently been received:

East Malling Research Station: Ann. Rpt. for 1936.
South-Eastern Agr. Coll., Wye: The Journal, July 1937.
Malta: Ann. Rpt. of Dpt. of Agr., 1935-36.
Nigeria: *Northern Provinces*, Ann. Rpt. for 1936.
Nyasaland: Progress Rpt. Geol. Survey Dpt. No. 6, 1936.
Northern Rhodesia: Ann. Rpt. of Dpt. of Agr., 1936.
Tanganyika Territory: Trade Rpt., 1936.
West Indies: *Grenada*, Ann. Rpt. of Dpt. of Agr., 1936.
West Indies: *St. Kitts-Nevis*, Ann. Rpt. of Dpt. of Agr., 1936.

576. Rothamsted Experimental Station. The abridged Report for 1936, recently received, contains an account of the steady progress made with the work in connection with grassland experiments, arable and vegetable crops, fertilizers, fermentation, soil microbiology, plant pathology, entomology, insecticides, etc. During the year a special building was constructed in which both farmyard manure and "artificial" farmyard manure can be produced under standard conditions. The library continued to expand and now contains some 27,000 volumes dealing with agriculture and cognate subjects. Many useful papers were published in various scientific journals.

577. Reports on the Work of Agricultural Research Institutes and on Certain Other Agricultural Investigations in the United Kingdom, 1934-35. (Min. of Agr. and Fisheries, London, 1937. Pubd. by H. M. Stat. Off. Price 5s. net.) This report summarizes the progress of agricultural research carried on with the aid of State grants during the academic year 1934-35 at Research Institutes and other centres in the United Kingdom. A list of the papers published during the year by each Institute or research centre is appended to each report. A list of the names and addresses of Directors of Research Institutes and those in charge of other centres of investigation is given in the appendix. A useful index is included.

578. EUROPE. Malta: *Cotton Cultivation*, 1935-36. (*Ann. Rpt. of Dpt. of Agr.*, 1935-36, recently received.) Cotton was cultivated on 57 acres—9 acres in Malta and 48 in Gozo. The yield was 12,748 lb. lint and 335 cwts. of cotton seed, compared with 7,910 lb. lint and 312 cwts. of cotton seed in the previous year.

579. ASIA. Ceylon: A Note on the Cotton Purchase System, 1936. By H. A. Peiris. (*Trop. Agriculturist*, lxxxviii., 5, 1937, p. 285.) The area under cotton was approximately 1,160 acres, and the total crop was 3,229 cwt. of seed-cotton, averaging 2¾ cwt. per acre. The season generally was good, although malaria was a factor that militated against the efficient cultivation and maintenance of the plots. In the Southern and Central Divisions the crop purchased was more than double that of the previous year, notwithstanding the fact that cultivators were considerably undermined in health. The purchase of the village cotton was undertaken by the Divisional Agricultural Officers acting as Agents for the Spinning and Weaving Mills, Colombo, where the cotton was finally despatched. The price paid for first-grade seed cotton was Rs. 12 per cwt. less handling and transport charges. The money was paid in full on the day of purchase, this method of spot cash payment being much in favour with the producers, who receive money at a time when, in most cases, it is urgently required for domestic needs.

580. AFRICA. NIGERIA: *Cotton Cultivation*, 1936-37. (*Half-yearly Rpt. of Dpt. of Agr. to March* 31, 1937.) *Northern Provinces.*—The weather conditions during the growing period, while not exceptionally good, were not unfavourable, and except in Northern Sokoto and Northern Katsina yields were little below average. The total yield, however, was considerably below the estimate, and was probably due to the competition from groundnuts in parts of Sokoto, Northern Katsina and in Kano Province. The greater part of the cotton in these areas was absorbed by the local weaving industry. There was a satisfactory increase in production in Zaria Province, and an excellent start was made in Bauchi Province, where markets were opened for the first time. Prospects for the development of cotton growing in this province are excellent, although the farmers still require a good deal of instruction in cultivation methods. An Agricultural Officer is now stationed in the province and it is anticipated that progress will be rapid. In the Niger Province dry weather during the planting season caused a decrease in production in some areas, but there was an encouraging increase in the Kontagora Emirate. The cotton marketing regulations operated satisfactorily and the high percentage of Grade 1 cotton was maintained. Prosecutions in respect of offences against the cotton regulations totalled 83. Eighty-five markets were gazetted for the purchase of cotton in the main cotton-growing provinces. The price paid (in pence per lb. of seed cotton) was $\frac{8}{10}$d. per lb. rising to 1$\frac{3}{10}$d. Some 6,120 tons of seed have been reserved for planting in the 1937-38 season.

Southern Provinces.—Owing to adverse weather conditions it was feared the crop would be a complete failure, but late rains greatly improved the situation and production is expected to reach 5,500 bales.

581. NORTHERN PROVINCES, NIGERIA: *Cotton Cultivation*, 1935-36. (*Ann. Rpt. of N. Provs.*, 1936.) In the Bauchi and Katagum Divisions experimental and demonstration farms have been opened in selected places, and American cotton seed has been distributed in quantities for the first time, and cotton bids fair to be a successful and increasing second export crop to groundnuts. Gazetted cotton markets have been opened in five districts, complete with hand gins, graders and buyers, and European trading firms are taking an increased interest in the possibilities of the province. In Bornu Province export cotton has been more extensively planted in Nguru and Gorgoram in the west, but any real progress in this industry is expected to come from the fertile lands in the north and east of Bornu. In the Katsina Province yields were lower in the northern areas, but sufficient progress was made in the south to warrant hopes of an increased production to offset the fall in the north. It is estimated that some 20,000 bales will be available for export. Mixed farming in the province is developing and is receiving encouraging attention from the peasantry. In the Niger Province the Emir of Bida started a mixed farm, which in its first year was doing well. Instruction to farmers on the advisability of early planting of cotton resulted in better crops being obtained. The development of cotton markets in Kontagora Division was attended with considerable success and 29 tons of cotton were exported. Some 12,000 tons of cotton were exported from Sokoto Province, and the importance of this province from a trading and economic point of view is annually increasing. In Zaria Province 8,600 bales were purchased compared with 11,400 bales in the previous season.

582. REPORT ON A VISIT TO NORTHERN NIGERIA TO STUDY MIXED FARMING. By C. W. Lynn. (*Bull.* 33, Dpt. of Agr., Gold Coast, 1937.) A study of the Nigerian system with a view to adapting it to Gold Coast conditions. The system will require numerous modifications, but in general is regarded as offering the best possible foundation for future prosperity in the Gold Coast. Part I. of the pamphlet discusses the origin of the term "mixed farming"; Part II. deals with mixed farming in Northern Nigeria (discussing Zaria, Kano, and "middle belt" conditions, organization of Agricultural Department for extension work, working details, etc.); Part III. deals with the introduction of mixed farming to the Gold Coast.

583. NORTHERN RHODESIA: *Cotton Industry*, 1935-36. (*Ann. Rpt. of Dpt. of Agr.*, 1936.) The cotton trials were repeated on a considerably larger scale, but those on the looser types of Kalahari sand were disappointing and rule out much of North-Western Rhodesia as possible cotton country. The existence of an agricultural station at Fort Jameson enabled trials to be initiated in the Luangwa Valley, where the population is dense and conditions appear to resemble those of parts of Nyasaland where cotton-growing has become an established industry. The trials have shown that the former limiting factor, stainer damage, can largely be evaded by growing cotton only under certain ecological conditions.

In many respects the 1936 trials were disappointing, but the fact remains that over a period of three somewhat unfavourable seasons certain districts produced native-grown crops equal in yield to those of the majority of African cotton-growing territories; moreover, the yields might well have been doubled had the plots been better cultivated. So long as the world price is over 6½d. per lb., there seems a better prospect in cotton than in maize when grown within reasonable distance of the railway line. A moderate cotton crop should bring in a return of 16s. to £1 per acre; only in the most exceptional circumstances would the native maize crop of a district yield even the lower of these returns. Unfortunately at the moment the native does not see things in this light, and it will take time to overcome his prejudices. There can be no doubt that an attempt to establish a cotton industry is well worth while, and it is not unreasonably optimistic to feel confident of some measure of success. Cotton will grow on soils which are incapable of producing a commercial maize crop; it will stand higher transport charges, and has a definite rotational value.

584. SOUTH AFRICA. THE ORGANIZATION OF AGRICULTURE, WITH APPLICATIONS TO SOUTH AFRICA. By H. D. Leppan. (Pubd. by Central News Agency, Johannesburg, South Africa, 1936.) An interesting brochure, commencing with a discussion of the present condition of "scarcity in the midst of abundance" with some of its causes. This is probably the greatest problem which lies before present-day statesmen. In this book the author endeavours to show that conscious planning should be able to achieve something better than blind competitive struggle. So many farmers, as compared with industrialists, being their own masters, organization is far behind that in industry, though even more necessary. Various attempts in this direction are described, and the breakdown of the Russian method of too great bureaucratic centralization is pointed out.

The actual South African situation is then considered in detail, and in the concluding chapter the author proposes the establishment of an Economic Advisory Council, whose members should serve for nine years (to avoid political influences) and should be empowered to co-opt others for any special work. This council should deal with all questions of land and its utilization, taking over land which its owners can no longer finance properly, and carrying out research in all directions.

585. MOISTURE AND FARMING IN SOUTH AFRICA. By W. R. Thompson. (*S. Afr. Agr. Ser. No.* 14. Pubd. by Central News Agency Ltd., Johannesburg, South Africa, 1936. Price 21s.) The central idea of this book is the moisture question, which is of paramount importance in South Africa not only for the crops and vegetation generally, but for the increasing needs of the increasing civilized population. The drought of 1932-33 alone is estimated to have cost the country £11,000,000 in losses. Owing to the lack of records it is by no means easy to find out whether, as is often alleged, the intensity of the rainfall is increasing, or whether the total rainfall is decreasing, but it is very important to ascertain this, not only in South Africa but elsewhere. Erosion and many other matters must also be considered.

There are many theories about the possible drying up of South Africa, and the author discusses all the different factors in the problem. The conclusion is reached, based on historical and meteorological evidence, that the total rainfall appears to show no permanent diminution. Both dry and wet periods have been experienced in the past with minor secular variations, and although the country's rainfall has been below the normal during the greater part of the present century, judging from the experience of the past, improved moisture conditions may confidently be expected in the future. Man's action is considered to have adversely affected the efficacy of the rainfall. The practices advocated by the farmer in South Africa in order to satisfy his requirements—the indiscriminate burning of vegetation, overstocking of veld resulting in deterioration of soil fertility and perpetuating the evil of soil erosion—have created conditions favouring a less efficient utilization of the available water supply. Owing to restriction of land now at his disposal, the farmer can no longer move at will to areas of greater rainfall when a drought occurs in his part of the country, and must adapt himself to the changed economic conditions. Droughts must be regarded as part of the national heritage, and under the more intensive system of farming of to-day, the preservation of reserve feed supplies for livestock during periods of drought, the necessity of preventing overstocking on farms, the systematic and discriminate utilization of the indigenous vegetation in such a manner as to derive optimum benefit without impairing it (which is a matter of urgent importance), and in general the promotion of such practices as will ensure the most efficient utilization of the available moisture, resulting in greater stability in production, should be cardinal points in South African farming policy.

The book contains many diagrams referring to rainfall, soil erosion, etc., and is furnished with a bibliography of 110 names, and an index.

586. SWAZILAND: *Cotton Industry*, 1936-37. (*Ann. Rpt. Emp. Cott. Growg. Corpn.*, 1935-36.) The season has been remarkable for the heavy rainfall all over the country; at the Experiment Station, Bremersdorp, over 40 inches fell between September and the end of February. In spite of some loss of crop by waterlogging and damage by hail, a good deal made satisfactory growth, and with the arrival of dry, warm weather, the cotton promised well in March. Damage by pests has been less than usual.

587. TANGANYIKA TERRITORY: *Cotton Industry*, 1935-36. (*Trade Rpt.*, 1936.) For the fourth year in succession the record in cotton output has been raised, in the ratio for the four years of 100 : 111 : 197 : 222. The figures for 1935, when a new high scale of production was established, were exceeded in 1936 by 13 per cent. in quantity and 12½ per cent. in value, creating fresh records in each case. While the bulk of the production was again in the Lake province, the relative increase was considerably higher in the Northern and Tanga provinces, the exports through Tanga, Moshi and Arusha being nearly two and a half times greater than in the previous year. The interim objective of the Agricultural Department is 100,000 bales; two years ago this seemed a remote ideal, but an export of over 63,000 bales in 1936 brings this much nearer to fulfilment.

588. UGANDA: *Cotton Prospects*, 1937-38. The report of the Dept. of Agriculture for June stated that there had been an improvement as regards early planting, and with the exception of the Eastern Province, weather conditions were favourable. There had been no serious incidence of pests or diseases, and crop prospects were encouraging.

589. AUSTRALASIA. QUEENSLAND: *Standover Cotton a Menace to Adjacent Cotton Fields.* (*Queens. Agr. J.*, April 1937, p. 431.) Standover fields, through the prolific weed growth associated with them, are breeding grounds for the major cotton pests. It is recommended that standover fields be ploughed before weed growth is apparent, and Rhodes grass planted at the rate of 8-10 lb. per acre, since this grass germinates only moderately well. Care should be taken to avoid sowing too deeply—dragging a brush harrow after broadcasting the seed usually gives ample cover in a normal season.

590. WEST INDIES. THE SEA ISLAND COTTON INDUSTRY, 1936-37. (*Trop. Agr.*, xiv., 7, 1937, p. 212.) The West Indian Sea Island Cotton Association reports that the production of those islands that planted in the fall of 1936, and reaped during the first five months of 1937, has fallen short of the crop anticipated. This is due to unfavourable weather conditions and to severe attacks of pests. Montserrat and St. Kitts, whose planting season is February to April, report that heavy sowings have been made, germination has been good, and provided that suitable weather conditions prevail a production of 3,000/3,500 bales may be expected.

Arrangements have been made by the Advisory Committee in England to cable reliable market information fortnightly to the Secretary of the West Indian Association, who has arranged to have the information published in each island. The most recent report indicates that supplies are short, and that prices range from 20d. to 24d. per lb.

591. GRENADA: *Cotton Industry*, 1936. (*Ann. Rpt. of Agr. Dpt.*, 1936.) Prices of cotton were good, ordinary Marie Galante from Carriacou realizing 7·50d. per lb. and Antilles 8·50d. per lb. The length of staple of Antilles cotton was 1½ inches to 1¾ inches, which is longer than most Egyptian cottons. The peasantry of Carriacou continue to apply for this cotton and seem to prefer it to Marie Galante. Some 2,520 lb. of Antilles cotton were distributed.

Selection work with Antilles cotton was continued. The chief point of importance in these new selections is the high lint index, which would indicate an increase in the yield of lint from 100 lb. of seed cotton amounting in the best case to over 7 lb. This advantage has not been obtained at a sacrifice of any important quality; the lint length is maintained as well as a reasonably high seed weight.

592. ST. KITTS-NEVIS AND ANGUILLA: *Cotton Industry*, 1936-37. (*Ann. Rpt. of Dpt. of Agr., St. Kitts-Nevis*, 1936.) On some estates in St. Kitts the crop was persistently attacked by cotton leafworm (*Alabama argillacea*), and in the late-planted fields pink bollworm caused serious losses to the crop. The value of the cotton lint exported was more than three times that of the lint exported in 1935, and was the highest since 1930. Some 3,000 acres were planted to cotton in Nevis. The seed germinated well, but excessive rains caused some of the plots to become overgrown with weeds; a dry spell later, however, helped the situation, and the crop was promising at the end of the year. Pink bollworm and cotton stainer were again troublesome, but attacks of leafworm were promptly dealt with. The purchasing of the peasants' cotton was again undertaken by the Government, an advance at the rate of 6 cents per lb. on clean Sea Island cotton delivered at the cotton house being made to growers. The cotton was shipped to the British Cotton Growing Association, and was sold at a price which allowed a bonus of 3·2 cents per lb. to the peasants after deducting expenses. In Anguilla cotton suffered from adverse weather conditions, attacks of pink bollworm, and, to a lesser degree, of cotton leafworm. An insect which has caused damage to freshly planted cotton seed during the past two seasons has been identified as the stink-bug of the family *Cydnidæ*, and various treatments have been suggested for its control.

Work on cotton selection was continued at St. Kitts, and spinning test reports on a sample of lint from one of the progeny rows of the St. Kitts cotton were very satisfactory.

COTTON IN EGYPT.

593. THE ALEXANDRIA FUTURES MARKET. By C. R. Barber. (Obtainable from the Editor, *Egyptian Gazette*, Alexandria, Egypt. Price 5s. 8d., post free.) A clear and readable account of the working of the Futures Market in Alexandria. Chapter I. discusses the necessity for insurance against price fluctuations; the growth of the futures market; the futures contract; relationship of futures and spot; correlation between world futures markets: Alexandria futures market usages; the evolution of the present contracts; tendering against futures contracts; some simple operations in futures; settlements. Chapter II. explains hedging operations; "basis," and fluctuations in "basis"; trading "on call"; advantages and disadvantages of "on call" system. Chapter III. deals with the uses of speculation; useful participation; harmful speculation; manipulation; speculative dealing in "options." Chapter IV. discusses relationship of futures months; carrying charges and carrying premiums; conditions tending to create "report" and "déport," conditions favourable and unfavourable to tendering. Various appendices are included dealing with the Futures Board; futures contract notes; brokerage on futures transactions; price parities between leading futures markets; cost of tendering.

594. STRENGTH, GRADE AND PRICE OF EGYPTIAN COTTONS. By H. A. Hancock. (*J. Text. Inst.*, xxviii., **6**, 1937, T177.) All the varieties composing the Egyptian crop are described, and their chief staple measurements and their yarn strength at a standard count are tabulated from observed data on fully representative samples. The causes and effects of "grade" are discussed, and it is shown that the percentage of taker-in waste is a good index to grade if the variety is known. It is shown that there is a close relationship between the yarn strength at a given count and the spot price of all kinds of Egyptian cottons.

595. EXPERIMENTS IN EGYPT ON THE INTERACTION OF FACTORS IN CROP GROWTH. VI. FURTHER EXPERIMENTS ON THE NITROGENOUS AND PHOSPHATIC MANURING OF COTTON. By F. Crowther *et al.* (*Bull. No.* 30, Tech. Ser. Roy. Agr. Soc., Egypt, 1937.) The present bulletin—the third to describe yields of cotton experiments—discusses experiments made in 1936 at several sites well distributed over the Delta. The major results confirm those of the earlier seasons. For instance, large yield increases from nitrogenous manuring were again obtained, and there is now no doubt that the use of fairly large amounts of nitrogenous fertilizer will be profitable to the farmer with the varieties which are at present popular in the Delta. New factors were examined in this series of experiments—viz., date of sowing, method and date of application of nitrogenous fertilizers, and the effect of sand-sowing. One result of special practical interest in view of the adoption of an early sowing date is that February sowings give better returns for nitrogenous manuring than later ones, and the farmer obtains a twofold additional crop resulting partly from earlier sowing and partly from the greater effectiveness of manuring. Increases in yield from phosphatic manuring were obtained in four out of the five experiments involving phosphate, but in all cases the increases were small compared with those from nitrogenous manuring at the same site. Sand-sowing and an additional early irrigation both produced a general increase in yield in the Qaliubia Province, but were without effect on response to nitrogen.

[*Cf.* Abstrs. **568**, Vol. XIII., and **214**, **215**, Vol. XIV., of this Review.]

COTTON IN THE UNITED STATES.

596. TRIPARTITE TECHNICAL CONFERENCE ON THE TEXTILE INDUSTRY. I. RECORD OF PROCEEDINGS. (Int. Lab. Off., Geneva, 1937.) The Conference was held at Washington, D.C., from 2nd to 17th April, and had for its object the discussion of all matters that would lead to the improvement of economic and social conditions in the textile industry on a world scale. Many resolutions were adopted, dealing with the need of expansion of consumption, of improved agricultural conditions, of relieving industry from oppressive quotas and tariffs, of co-ordinating the interests of producers and consumers, and of improving social conditions, etc.

597. AMERICAN COTTON PROSPECTS: INCREASING "OUTSIDE GROWTHS" TO BE TAKEN INTO ACCOUNT. By W. H. Slater. (*Text. Wkly.*, xix., **483**, 1937, p. 711.) A criticism of American policy. Viewed inside the United States, with its ideal of self-sufficiency, this policy might be good, but in the long run America is going to sacrifice her foreign markets for American raw cotton. The basic trend in world cotton production is rising, and it is rising in total quicker in countries outside U.S.A. than American cotton production is rising.

598. AMERICAN COTTON BELT: AGRICULTURAL POLICY. (*Wirtschaftsdienst*, **22**, 1937, p. 655. From *Summ. of Curr. Lit.*, xvii., **12**, 1937, p. 332.) Recent tendencies to introduce mixed farming in the Cotton Belt, so as to improve the impoverished soil and to make the farmer more self-supporting, are discussed with statistics. It is reported that in the chief cotton states there are half a million farms without a cow or pig; to such an extent does cotton monopolize the land.

599. THE INFLUENCE OF THE AAA COTTON PROGRAMME UPON THE TENANT, CROPPER, AND LABOURER. By F. C. Frey and T. L. Smith. (*Rural Sociol.*, 1, **4**, 1936. From *Exp. Sta. Rec.*, 76, **5**, 1937, p. 714.) The AAA cotton-reduction programme has greatly curtailed the annual migration of families (tenants and croppers) from one plantation or farm to another. The increased income from cotton has enabled the planter to be more generous in his advances, and the tenants and croppers know that if they leave their present location they may not be able to find another where a quota of cotton is to be had.

600. AMERICAN COTTON: ENVIRONMENT MAY CHANGE CHARACTERISTICS. (*Int. Cott. Bull.*, xv., **59**, 1937, p. 372). Experiments have recently been undertaken by the U.S. Dept. of Agriculture to find out what characteristics of cotton varieties are kept relatively stable under widely different environments. At least 64 different characteristics of the cotton plant and fibre are being studied during the three-year test. These fall under the general classifications of growing conditions, gin data, fibre properties, and spinning utility. The first year of study indicates that characteristics such as staple length, lint per cent., weight of lint per 100 seeds, and lint fineness do not change greatly as environment changes; but characteristics such as yield, time required for germination and to reach blooming stage, time of opening, and maturity of fibre, are modified to a considerable extent by seasonal conditions present at the various locations.

601. FIBRE FINENESS OF AMERICAN COTTON. (*Int. Cott. Bull.*, xv., **59**, 1937, p. 411.) Recent tests by the U.S. Fibre and Spinning Laboratories show that yarns made from cut Sea Island fibres have given strength approximately 50 per cent. greater than that of yarns made from natural-grown American cotton of similar staple lengths. A short staple cotton (Hopi) of $\frac{13}{16}$-inch staple has been found with such fineness and related fibre properties as to give spinning results ordinarily obtained with Delta 1¼-inch cotton. In crossing this cotton with

Acala the first generation cross of Hopi-Acala, 1⅛-inch staple length, has given spinning results comparable with those obtained from cotton of 1½ inches in staple length. Yarns made from such fine-fibred cottons require less twist than cottons of like staple length, thus reducing the cost of manufacture. Studies and selections are now being made with hundreds of samples representing further crosses with Hopi and Upland types, and between Sea Island and Upland types, grown in different parts of the country.

602. RESEARCH WITH FIELD CROPS IN THE BUREAU OF PLANT INDUSTRY. (*U.S. Dpt. of Agr., Bur. Plant Indus. Rpt.*, 1936. From *Exp. Sta. Rec.*, 76, **5**, 1937, p. 617.) The work with cotton included breeding and fertilizer experiments; improved methods of ginning long-staple cotton; community production of cotton.

603. AMERICAN COTTON TEXTILE INDUSTRY: CHANGES, 1900-1936. By P. M. Strang. (*Cotton*, U.S., 101, **1**, 1937, p. 58. From *J. Text. Inst.*, xxviii., **5**, 1937, A293.) A table is presented which shows the effect on the manufacturer, the textile worker, the cotton dealer, and the cotton farmer, of a number of modern developments, such as the growth of the tyre industry, the development of rayon, the southward drift of mills in the U.S.A., and so forth. The table is discussed.

604. QUALITY OF COTTON LINTERS PRODUCED IN THE UNITED STATES, SEASONS 1934-36. By V. R. Fuchs. (*U.S. Dpt. of Agr., Bur. of Agr. Econ.*, 1937.) A report of "results obtained in a study of the quality of cotton linters produced in the United States and of the use in the cottonseed-crushing industry of official standards of the United States for American cotton linters."

605. A SUMMARY OF DATA ON ABORIGINAL COTTON OF THE SOUTH-WEST. By V. H. Jones. (*Univ. New Mex. Bull.* 296, 1936. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 410.) A survey of the anthropological, historical and other literature on this problem. Aboriginal cotton of the south-west U.S.A. probably all belongs to the one species *Gossypium hopi* Lowton, a relative of *G. hirsutum.* This species is unique in combining fineness of fibre with short staple length (about 0·8 inch), and is being used by the United States Department of Agriculture in breeding a fine cotton of medium staple length.

606. ARKANSAS: *Agronomic Research.* By M. Nelson *et al.* (*Arkansas Sta. Bull.*, 337, 1936. From *Exp. Sta. Rec.*, 75, **5**, 1937, p. 617.) Work on cotton included varietal trials and breeding experiments; residual effects of winter cover crops sown in cotton middles on subsequent cotton yields; interplanting of legumes in corn and the effects on yields of the succeeding crop of oats and cotton; cotton fibre investigations, including the development of a method of sorting fibres as to length by a photo-electric cell; and studies of quality of fibre of pure lines of cotton. The fertilizer studies dealt with different formulas, rates of application, placement, home *v.* factory mixed, side dressing, and nitrogen carriers.

607. PLANTATION OPERATIONS OF LANDLORDS AND TENANTS IN ARKANSAS. By H. W. Blalock. (*Bull. No.* 339, Agr. Exp. Sta., Univ. of Arkansas, 1937.) An attempt "to picture the cotton plantation in Arkansas as an operating enterprise; to study the inputs and outputs of the plantation as a whole, of the landlord, and of each of the tenant classes; to analyze the relationships between landlord and tenants; to show the social and economic contributions of the plantation to the welfare of both tenants and landlords; to point out causes for variations of financial returns to landlords and tenants; and to indicate methods for improving the welfare of persons directly connected with cotton plantations.

608. QUALITY OF COTTON IN ARKANSAS AND MISSOURI, 1928 TO 1935. By W. B. Lanham *et al.* (*U.S. Dpt. of Agr., Bur. of Agr. Econ.*, 1937.) The report presents information concerning the following: grade and staple of Arkansas cotton; quality of cotton produced in Arkansas and Missouri compared with that of cotton produced in the United States as a whole from 1928 to 1935; differences in quality of cotton ginned in various sections of Arkansas and Missouri during these years; variations in cotton quality occurring from year to year in Arkansas and Missouri; some information on the ultimate destination of cotton shipped from Arkansas and Missouri during 1932-33.

609. A REPORT ON THE PRODUCTION OF COTTON IN THE PANHANDLE OF OKLAHOMA. By H. A. Daniel. (*Bull.* 61, Panhandle, Oklahoma, 1936. From *Exp. Sta. Rec.*, 76, **5**, 1937, p. 620.) Since the annual yield of seed cotton averaged only 202·1 lb. during the period under review, 1924-36, it is considered that cotton is not an economic crop compared with wheat or sorghum.

610. SOME ECONOMIC PROBLEMS OF COTTON GINS IN OKLAHOMA. By R. A. Ballinger and R. C. Soxman. (*Oklahoma Sta. Bull.* 231, 1936. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 866.) A comparison of number of gins, outturn, etc., between 1926-7 and 1932-3. Snapped cotton made up 52·5 per cent. of the cotton ginned during the four years.

COTTON IN FOREIGN COUNTRIES.

611. COTTON CULTIVATION IN LATIN AMERICA. By H. G. Smith (*Indus. Textil.*, 6, **64**, 1937, p. 19. From *Summ. of Curr. Lit.*, xvii., **12**, 1937, p. 332.) The development of cotton growing in Brazil, Argentina, Peru, Mexico, and Paraguay is discussed with special reference to economic factors. Statistics are tabulated.

612. ARGENTINA: *Cotton Crop Prospects.* (*Text. Wkly.*, xx., **491**, 1937, p. 133.) The estimate of 243,000 bales of 500 lb. for 1936-37 has been revised to 192,000 bales, compared with 373,000 bales in 1935-36, according to the official estimate of the Argentine Government. The reduction is ascribed to severe drought and insect damage. More than 1,000,000 acres were planted to cotton this year, and 713,000 acres were harvested, against 763,000 acres harvested in 1935-36.

613. LA ECONOMIA ALGODONERA NORTEAMERICANA. By C. G. Mata. (*Bull. No.* 18, Min. de Agr., Junta Nac. del Algodon, Buenos Aires, 1936. In Spanish.) A study of the economics of the cotton industry in the United States, with detailed figures to show the effects of various factors upon prices, etc.

614. LOS TRABAJOS ECOLOGICOS ALGODONEROS EN EL ANO 1935-36. (*Bull. No.* 19, Min. de Agr., Buenos Aires, 1937.) A study of cotton yields in Argentina under different ecological conditions.

615. EL COSTO DE PRODUCCION DEL ALGODON EN 1935-36. (*Bull. No.* 22, Min. de Agr., Buenos Aires, 1937.) A study of the costs of production in Argentina and of the possibility of their reduction. The costs of seed, insecticides, transport, rent, interest, salaries, and other factors are dealt with.

616. BELGIAN CONGO: *Le Coton.* (*Bull. Trimes. du Com. Cotonn. Congolais*, ii., **6**, 1937, p. 49.) A series of short articles dealing with every phase of the cotton industry in Belgian Congo, including: botany of cotton, cultural methods, scientific research, development of cotton cultivation, legislation, ginning and pressing, transport, imports and exports, statistics, etc.

617. La Ferme Indigène. By A. Ravet. (*Bull. Trimest. du Com. Cotonn. Congolais*, ii., **4**, 1937, p. 5.) The Nigerian system of mixed farming, with the usual modifications demanded by local conditions, is being shown to the natives of the Belgian Congo by means of demonstration farms, and is exciting great interest.

618. Guide pour l'Enseignement Pratique de la Culture du Coton. (Comité Cotonnier Congolaise, 1937.) A simple and well-illustrated guide for teaching natives the cultivation of cotton.

619. La Culture du Coton dans le District du Congo-Ubangi, 1933-35. By C. Leontovitch. (*Bull. Agr. du Congo Belge*, xxviii., **1**, 1937, p. 35.) Cotton production increased from 60,000 kilos in 1924-25 to 1,800,000 kilos in 1933-34. Of about 110,000 adult men in the district, 79,000 planted cotton on some 21,000 hectares, the average production being 55 kilos or 124 lb. per hectare. Planting on land hitherto reserved for food has begun, and a rotation has been recommended for a seven-year cycle: (1) maize, or maize with pumpkins, with cotton to follow; (2) groundnuts, sesame, rice, sorghum or maize, interplanted later with bananas or manioc; (3) bananas or manioc; (4) bananas; (5, 6, 7) fallows. The reasons for this treatment are discussed. The article goes on to discuss the preparation of the land for sowing of cotton, etc.

620. Brazil: *Cotton Industry*. (*Int. Cott. Bull.*, xv., **59**, 1937, p. 348.) Production of cotton yarn in Brazil is said to approximate 251,000,000 lb. a year. It is claimed that existing spinning equipment has been unable to meet the steadily increasing demand for yarns, particularly for 50's and finer counts, and that much of the spinning equipment is very old, inefficient, and unsuited to current needs. The trend of demand is towards finer counts, and there is difficulty in supplying these without importing them.

621. Cotton Progress in Brazil. By N. S. Pearse. (Int. Federn. of Master Cotton Spinners and Manufrs. Associations, Manchester, 1937. Price, 10s. 6d.) A most useful book for all interested in Brazilian cotton, while it also contains so many other items of information not always easily accessible that no one interested in that country can afford to neglect it. Starting with a general survey, the history of cotton in Brazil, and the climate, are discussed. The varieties grown are then dealt with, especially Moco, which is said to be the best perennial variety grown in Brazil, with a staple of 32-45 mm., very strong, silky, and of a creamy colour. It is capable of withstanding drought better than any other variety. The ginning laws, cotton presses, and classification service are discussed. Cost of production is difficult to determine, but the author considers that 2d. a lb. of lint is not an underestimate, and this leaves a fair margin for profit. Pests are then considered, and it is thought that though numerous (luckily not including the boll weevil), they are not at present as dangerous as in the United States and Egypt. The remaining chapters of the book give detailed descriptions of the cotton-growing industry and other matters in each of the fourteen cotton-growing states. The author finds some support for the contention that Brazilian cotton is lacking in uniformity, but he is of opinion that São Paulo can easily become a more prominent factor in world cotton production provided that coffee prices do not experience a considerable rise and make Brazil neglect cotton, and that exchange fluctuations do not discourage would-be foreign buyers. In any case, the cost of production in Brazil is so much lower than in many other important cotton-growing countries that the planters there can make a profit when growers in other countries can barely make ends meet.

622. China: *Cotton Industry*, 1936. (*Chinese Econ. Jour. and Bulletin*, xx., **5**, 1937, pp. 493 and 561.) The total number of spindles reached 5,071,122, showing an increase over the preceding year of 118,296. This increase in spindleage was, however, only seen in foreign mills, while in Chinese mills the number actually dwindled, a fact that should call for serious attention.

A large-scale cotton spinning and weaving factory will shortly be established near Pahsien, Szechuen, under the joint auspices of the Kincheng Banking Corporation and the Ming Sung Industrial Company. It will be known as the Chialing Spinning and Weaving Factory, and will be capitalized at $3,500,000. The machinery has been ordered from abroad and is expected to arrive some time in September. The mill will commence operations next spring.

623. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No.* 26, 1937, contains the following among other papers: "La culture du cotonnier en Côte d'Ivoire"; a brief account of the industry. Production in 1935-36 amounted to 9,999 tons. "Remarques sur le développement de la culture du cotonnier et les méthodes de production du coton dans les colonies portugaises" (C. de M. Geraldes). "Influence de la culture du coton sur la filature." *Bull. No.* 27 contains the following among other papers: "Les facteurs économiques du cours des cotons bruts" (D. de Prat); "La culture du cotonnier au Brésil" (P. Tissot); a brief account of the industry. Importation of Japanese has solved the labour problem for the time being, and the future is full of promise. "Valeur papetière des tiges de cotonnier"; cotton stalks give only a poor return of cellulose—35 per cent., which is only 78 per cent. pure, and their value in paper making is considered to have been exaggerated.

The usual notes on cotton in the French colonies and other countries, cotton legislation, marketing, etc., are included.

624. RUSSIA: *Cotton Cultivation in U.S.S.R.* (*Int. Rev. Agr.*, **28**, 1937. From *Summ. of Curr. Lit.*, xvii., **9**, 1937, p. 247.) The area for 1937 is estimated at 5,163,000 acres, 3,886,000 acres being under irrigation. American long-staple varieties are selected for nearly half the area, and Egyptian cotton is to be grown on 309,000 acres. In 1936 yields of seed cotton averaged 1,258 lb. per acre in the irrigated regions, and 1,445 lb. in Uzbekistan; 64 per cent. of the crop was of $1\frac{3}{32}$ to $1\frac{3}{16}$ inch cotton.

625. ON THE COTTON REGIONS OF AZERBAIJAN. By P. M. Zukovskii. (*Bull. No.* 11, Lenin Acad. of Agr. Sci., 1936. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 410.) The need for cotton varieties resistant to diseases and pests is indicated, and some new selections from the American type "Special Mead" are mentioned.

626. NEW TEXTILE MILL. (*Text. Rec.*, lv., **651**, 1937, p. 72.) The building of a large mill for the manufacture of fine cloth with an annual output capacity of 11 million metres has been commenced at the Darnitsa Forest near Kiev. The spinning and weaving shops will cover an area of 20 acres. New looms, of a type hitherto not used in the U.S.S.R., are being installed in the mill. The speed of the looms is twenty-five to thirty times greater than that of existing looms in the Union. It is estimated that from 12 to 24 looms will be operated by one weaver. The new mill will be put into operation early in 1939.

SOILS AND MANURES.

627. SOIL CONDITIONS AND PLANT GROWTH. By Sir E. John Russell, D.Sc., F.R.S. (Longmans, Green and Co., London, New York, Toronto. 1937. Price 21s. From *Bull. Imp. Inst.*, xxxv., **2**, 1937, p. 275.) This is the seventh edition of this important work. In order to keep the reader informed of the rapid advance of knowledge, and at the same time keep the book within reasonable compass, it has been necessary to carry out an exceptionally thorough revision. Large sections have been rewritten, some being expanded and new matter added, while in other cases less important matter has been omitted. Among the new material, the section on nitrogen nutrition of the plant has been extended; recent work on the importance of very small quantities of certain elements formerly regarded as non-essential, such as boron and zinc, is included; and there is a useful table indicating the appearances in the growing plant corresponding with certain external conditions. In dealing with the composition of the soil, the latest work on theories of clay structure, the mechanism of base exchange, and the properties of soil organic matter, is well covered. The section on the water relationships of soil and plant has been extensively revised and includes a new section on the work, particularly of Schofield, on the "capillary potential" or pF of the soil. The deleted matter includes the Appendix on Analytical Methods, now unnecessary, as there are special text-books dealing with this branch of soil science. The bibliography has been somewhat shortened, but this condensation is more than balanced by the numerous references to literature given in the body of the book itself.

628. SOIL MICROBIOLOGY. By S. A. Waksman. (*Ann. Rev. of Biochem.*, V. *Stanford Univ. Press, Calif.* Vol. V., 1936, p. 561. From *Exp. Sta. Rec.*, 76, **4**, 1937, p. 450.) This review deals in turn with the nature of the soil population; autotrophic bacteria; non-symbiotic and symbiotic nitrogen-fixing bacteria; cellulose- and hemicellulose-decomposing and other heterotrophic bacteria in the soil; *Actinomyces* and fungi in the soil; soil fungi causing plant diseases; mycorrhizas; algæ, protozoa, and nematodes in the soil; the decomposition of plant and animal residues; mutual relationships between root systems of higher plants and micro-organisms; and the influence of environment on the activities of soil micro-organisms. The literature list contains 165 entries.

629. PROBLEMS IN SOIL MICROBIOLOGY. By D. W. Cutler and L. M. Crump. (Longmans, Green and Co., London, 1935. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 757.) The contents are: the suitability of the soil for micro-organisms; the bacterial population under field conditions; the relation of bacteria to nitrite; carbon dioxide production by soil; the growth of protozoa in pure culture; the behaviour of protozoa in soil; the interactions between the soil organisms; a list of literature cited; an index; and a map showing protozoan distribution.

630. THE APPLICABILITY OF ALKALINE PERMANGANATE FOR OXIDATION OF ORGANIC MATTER IN SOILS FOR MECHANICAL ANALYSIS. By J. N. Chakraborty. (*Soil Sci.*, 42, **4**, 1936, p. 261. From *Exp. Sta. Rec.*, 76, **4**, 1937, p. 448.) A method of mechanical analysis using alkaline permanganate for oxidation of organic matter has been shown to yield results comparable with those given by the International-A method "in the case of various Indian soils—*e.g.*, ordinary arable, forest, gypseous, peat and lateritic soils. Thus the method appears to be a general method for mechanical analysis of soils. This is particularly suitable for soils rich in organic matter and is recommended for use in tropics where hydrogen peroxide is not very stable. Alkaline permanganate requires only a short time for oxidation of organic matter. Soils containing gypsum should be passed through a 70-mesh sieve to remove coarse gypsum after oxidation with alkaline permanganate and before addition of hydrochloric acid."

631. DISPERSION OF SOIL FOR MECHANICAL ANALYSIS BY SODIUM CARBONATE OR SODIUM OXALATE TREATMENT. By A. N. Puri. (*Soil Sci.*, 42, **4**, 1936, p. 267. From *Exp. Sta. Rec.*, 76, **4**, 1937, p. 448.) The proposed method "consists in the estimation of exchangeable Ca and free acidoid, sodium carbonate or oxalate equivalent to the former and sodium hydroxide equivalent to the latter being subsequently added and the soil suspension shaken overnight. To attain maximum dispersion, soils rich in organic matter require boiling with H_2O_2 or ammonium carbonate in addition to the foregoing treatment. It is obvious that soils containing excessive amounts of soluble salts or gypsum cannot be dispersed by any single treatment, for the salts will appear as clay even if the soil does not become flocculated. Such soils must first be leached with water to rid them of soluble salts and then shaken with $BaCO_2$ to make the calcium sulphate ineffective."

632. L'IMPORTANCE DE LA RÉACTION DU SOL EN CULTURE COTONNIÈRE ET L'UTILITÉ DE L'EMPLOI DES CENDRES. By H. de Saeger. (*Bull. Agr. du Congo Belge*, xxvii., 4, 1936, p. 593.) The attacks of *Helopeltis* observed during the last two years in Tanganyika have been found to be correlated with certain soil reactions. The greater the acidity of the soil the greater appears to be the attack; at pH5 it was most serious, at 6.5 to 7 it was much less so. The degree of acidity indicates the richness or poorness of the soil in certain necessary elements. When the soil varies away from the optimum content, the plants suffer in different ways. Incineration of the detritus is recommended as a means of destroying excess acidity. A bibliography is appended.

633. SOIL EROSION AND ITS CONTROL. By Q. C. Ayres. (McGraw-Hill Book Co., New York and London, 1936. From *Exp. Sta. Rec.*, 76, 5, 1937, p. 699.) This is a treatise on the subject of erosion control, in which an attempt is made to bring together a general introduction to and correlation of all phases of the problem with the quantitative application of such data as are known at present. The author points out that the apparent disproportionate emphasis accorded to engineering phases of erosion control is partly attributable to the fact that more information of a practical and time-tested nature is available from that standpoint. Chapters are included on factors affecting rate of erosion, methods of control, rainfall and run-off, terrace design, terrace location—principles and practice, terrace construction methods and machinery, terrace construction costs and maintenance, terrace outlets, control of gullies, temporary and semi-permanent check dams, permanent or soil-saving dams, special uses of vegetation, and soil conservation and land use. An appendix deals with simple methods of calculating land areas, partial lists of soil conserving and depleting crops and of plants favourable to soil conservation and wild life, and other data.

634. NATURAL PROTECTION FROM SOIL EROSION. By S. D. Timson. (*Rhod. Agr. Jour.*, xxxiv., 2, 1937, p. 146.) Brief descriptions of the following plants and grasses which may be planted to keep down erosion: *Paspalum dilatatum*, Rhodesian Sudan grass, Swamp couch, Creeping False Paspalum, Kikuyu grass, Para grass, Woolly finger, Vi-Vi, Napier fodder, Kudzu vine, Star grass, Sunnhemp, etc.

635. SOIL EROSION IN CYPRUS. By A. Pitcairn. (*Bull. No.* 3, Dpt. of Agr., Cyprus, 1937.) Pt. I. directs attention to the alarming nature of the subject, and gives a brief definition of the various types of erosion. Pt. II. describes the conditions which are allied to or conducive to erosion in Cyprus. Pt. III. discusses the history of erosion, the main factors causing it, and the present extent of erosion in the Island. Pt. IV. deals with the erosion measures practised and further measures contemplated. Pt. V. is a summary of conclusions. The report is furnished with several illustrations.

636. CHEMICAL NITRIFICATION IN SOIL. By G. de Rossi. (Third Internatl. Cong. Soil Sci., Oxford, Eng., 1935. From *Exp. Sta. Rec.*, 76, 5, 1937, p. 597.) Referring to the observations of Rao and Dhar with respect to photochemical nitrification, the author finds that heat, rather than light, is the important factor in non-biological nitrification. He states, in part, that "my work shows that, under perfectly normal conditions, ammonia naturally existent in the soil undergoes a process of oxidation until nitric acid is produced, and this quite independently

of any microbiological activities, quite apart from any influence exercised by light. This process, however, is particularly favoured by a moderate degree of heat, such as may be experienced in any land through the agency of the sun's rays in the spring, summer, and autumn." He also describes briefly a technique by means of which " a demonstration of this assertion (above quoted) is very simple."

637. SELENIUM ABSORPTION BY CROP PLANTS AS RELATED TO THEIR SULPHUR REQUIREMENT. By A. M. Hurd-Karrer. (*J. Agr. Res.*, 54, **8**, 1937, p. 601.) Wide differences in the absorption of selenium from sodium selenate by 19 different crop plants grown in Keyport clay loam, untreated with respect to sulphur, were directly correlated with corresponding differences in their respective sulphur-absorbing capacities. The parallelism suggests that the sulphur requirement of the plant determines its tendency to absorb selenium.

638. SELENIUM OCCURRENCE IN CERTAIN SOILS IN THE UNITED STATES, WITH A DISCUSSION OF RELATED TOPICS. By H. G. Byers. (*U.S. Dpt. Agr. Tech. Bull.* 530, 1936. From *Exp. Sta. Rec.*, 76, **5**, 1937, p. 590.) Considerable areas exist in the U.S. where vegetation is rendered more or less toxic by the presence of selenium. The data show that the degree of toxicity varies within wide limits for given plants, even for soils of similar selenium content, and also for different plants upon the same soil; that irrigation, with underdrainage, tends to diminish the selenium content of the soil; and that if the irrigation water contains sulphates, irrigation diminishes the selenium content of the vegetation.

639. EFFECT OF FARMYARD MANURE IN NORTHERN NIGERIA. By K. T. Hartley. (*Emp. Jour. of Exp. Agr.*, v., **19**, 1937, p. 254.) The field experiments described show that the remarkable returns obtained from small dressings of farmyard manure at Samuru, Zaria, are to be attributed very largely to the phosphorus which it supplies. Similar increases in yield can be obtained from equivalent dressings of superphosphate, but not of rock phosphate. The value of artificial nitrogenous manures is doubtful.

640. GREEN MANURING IN SOUTHERN NIGERIA. By H. C. Doyne. (*Emp. Jour. of Exp. Agr.*, v., **19**, 1937, p. 248.) Analyses of soil samples taken at the beginning and end of the growing season, at Ibadan, Southern Nigeria, from plots where a green crop had been dug in, are compared with those where it had been burnt. For the last five years there have been no significant differences in yields between the succeeding maize crops. Owing to the failure of the crop and a prolonged drought after the early rains, a large accumulation of nitrates occurred on both sets of plots, the " green " plots containing more than the " burnt " plots. At the end of the season the nitrate content was considerably reduced, but was still slightly higher on the " green " plots. The content of soluble salt, other than nitrates, the pH values, exchangeable-base content, available phosphorus content, and base-saturation were higher on the " burnt " than on the " green " plots. The " green " plots contained more total nitrogen, and absorbed more bases than the " burnt " plots both at the beginning and end of the growing season. There was a significantly greater loss in available phosphorus from the " burnt " plots than from the " green " plots during the growing season. The necessity for nitrogenous manuring in the tropics is discussed.

[*Cf.* Abstr. **99**, Vol. XII. of this Review.]

641. COMPOST: A NOTE ON METHODS OF REDUCING THE COSTS. By S. D. Timson. (*Rhod. Agr. Jour.*, xxxiv., **6**, 1937, p. 466.) Farmers all over the Colony have taken up the manufacture of compost manure during the past year, some of them on a large scale. The chief obstacle to its general adoption into farm routine is the question of the economical collection of the raw materials required for making it, such as grass and sunnhemp. The two simple and inexpensive implements described may help to solve this difficulty—the Hosier Hay Sweep and a home-made Ox-drawn Hay Sweep.

642. COMPOSTS AND COMPOSTING. By V. A. Beckley. (*E. Afr. Agr. Jour.*, ii., **5-6**, 1937, pp. 384 and 470.) The basal ideas of the Indore technique, as set forth by Howard and Wad, are receiving wider and wider application as the necessary modifications to suit local needs are discovered. This article deals in an interesting way with the various successful modifications of this system in use in Kenya Colony.

643. FARM COMPOST. (*Rhod. Agr. Jour.*, xxxiv., **6**, 1937, p. 449.) In *Bull.* 369 of the Missouri Experiment Station, W. A. Albrecht writes " that such materials as straws, cornstalks, cotton hulls and other organic residues were composted easily by adding 67·5 lb. of ammonium sulphate, 60 lb. of fine limestone, and 22·5 lb. superphosphate per ton dry matter. It was found practicable to add the mineral nutrient mixture while the straw, for example, was coming from the thresher. When piled to a height of 6 feet with flat top so as to take the rain, the decay will proceed as the moisture allows. Such composting may also be done by hand, but it is less laborious when the chemicals are applied through the machine. Farm trials of the resulting manure warrant wide consideration of this process as a help in getting more organic matter into the soil."

644. FARM MANURE: ITS VALUE AND CONSERVATION. By R. C. Collison and H. J. Conn. (*Farm Res.*, iii., **2**, 1937, New York State Sta. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 762.) The value of farmyard manure in building up soil fertility and tilth is briefly discussed, and practical suggestions are made for handling such material in a way to avoid the loss of its most useful constituents.

645. THE MANUFACTURE OF HUMUS FROM THE WASTES OF THE TOWN AND THE VILLAGE. By Sir Albert Howard. At the beginning of this paper the author emphasizes a point that has been too much neglected: " In China the processes of decay receive just as much attention as the processes of growth; the wheel of life is balanced." He points out the contrast shown in such countries as the United States, where the loss of organic matter has been followed by the destruction of the natural crumb structure of the soil, resulting in extensive erosion. The paper is mainly devoted to the important subject of the waste of municipal refuse, estimated to amount in the world to nearly two million tons a year. Already a number of towns have adopted, with various modifications to suit their local conditions, the processes here described, and there can be little doubt that progress in this direction will be rapid.

CULTIVATION, IRRIGATION, GINNING, ETC.

646. INCOMPLETE RANDOMIZED BLOCKS. By F. Yates. (*Ann. Eugen.*, Cambs., **7**, 1936, p. 121. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 353.) A new method of arranging replicated experiments in randomized blocks when the number of treatments is greater than the number of experimental units in a block, is described. The arrangement is such that every two treatments occur together in a block the same number of times. The method of working out the experimental results by means of an analysis of variance is described and illustrated. A discussion of the relative efficiency of this arrangement and one in ordinary randomized blocks is given.

647. METHODS OF STATISTICAL ANALYSIS. By C. H. Goulden. (Burgess Pubg. Co., Minneapolis, 1936. Price $3.00. From *Sankhya*, Book Reviews, iii., **1**, 1937, p. 89.) This is a practical or laboratory handbook for statistical workers. Methods of computation are given in great detail with precise and clear instructions, and illustrated with numerical examples. The treatment is definitely on the lines of Fisher, and the use of the formulæ for small samples and the method of analysis of variance is emphasized throughout.

648. AN EXAMINATION OF AN ANALYSIS OF A SERIAL EXPERIMENT. By J. B. Hutchinson and V. G. Panse. (*Agr. and Livestock in India*, vii., **3**, 1937, p. 332.) A criticism of a method used by R. D. Bose in 1935 in analyzing a series of variety tests of oats. The authors state that the error variances of the component trials in Bose's serial experiment differ significantly, and a combined analysis of variance is therefore not permissible. Bose's partition of the degree of freedom is discussed, and it is shown that he has misunderstood the significance of blocks. The degrees of freedom have been reapportioned and the analysis carried out in the correct manner, assuming homogeneous error variances. The authors also discuss the interpretation of the results of analyses of variance of the component trials, and show that conclusions can be drawn from them with almost as much confidence as from the combined analysis.

649. MECHANIZATION OF COTTON SEED DISINFECTION WITH FORMALIN. By J. A. Meissakhovitch and I. D. Medvedeff. (In Russian.) (*Mech. of Plant Protection, Bull. Pl. Prot., Leningrad*, Ser. III., "Control Measures and Implements," 1936. From *Rev. App. Mycol.*, xvi., **4**, 1937, p. 249.) A tabulated account is given of preliminary tests in 1935, the results of which showed that cotton seed disinfection by formalin against blackarm can be satisfactorily and economically effected with Heid's cereal seed disinfecting apparatus, with some technical modifications in its construction. The seed is fed by a hopper into a tank containing formalin, from which it is raised by means of an Archimedean screw, rotating in a galvanized iron cylinder inclined at an angle of 35°. The tests showed that three workers can disinfect up to 1,050 kg. cotton seed per hour with the help of this hand-driven apparatus, and that if the working of the machine could be made continuous its output could be brought up to 1,460 kg. seed per hour.

650. COMPETITION BETWEEN COTTON VARIETIES IN ADJACENT ROWS. By J. R. Quinby *et al.* (*J. Amer. Soc. Agron.*, **29**, 1937, p. 269. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 413.) In two series of experiments no consistent statistically significant effect of competition between adjacent rows of different varieties of cotton was detected. It appears safe, therefore, to use single row plots and use the space thus saved for additional replications. To guard against possible competition effects which have not been detected, randomization is essential.

651. CARBOHYDRATE CONTENT OF COTTON PLANTS AT DIFFERENT GROWTH PERIODS AND THE INFLUENCE OF FERTILIZERS. By D. R. Ergle. (*J. Amer. Soc. Agron.*, 28, **10**, 1936, p. 775. From *Exp. Sta. Rec.*, 76, **4**, 1937, p. 471.) Periodic changes in concentration of certain carbohydrate fractions of the cotton plant and the effect of fertilizers on these concentrations, determined from the time of emergence from the soil to the time of first picking, were studied near Elgin, Texas, by the U.S.D.A. Bureau of Plant Industry. The total sugars, representing the soluble carbohydrates, decreased in concentration in the plant tops between the stages of seedling and square formation, after which the trend in concentration was upward and increased rapidly during active boll formation, the rate of increase diminishing as the bolls approached maturity. At maturity, when the bolls began to open, the total sugars began decreasing in concentration. Except for the period of active boll formation, when the concentration of total sugars in both tops and roots increased rapidly, the course of changes in concentration of total sugars in the roots tended to be opposite to that in the plant top. During the period of study, the concentration of total sugars in the roots exceeded that in the tops. The diose sugars of the roots exceeded by a large margin the concentration of monose sugars. In the tops the difference in concentration of the two sugars was influenced by the development stage and the fertilizer. In general, during the latter stage of boll formation, July 9 to August 6, the monose sugars exceeded in concentration the diose sugars. The monose sugars in the tops and the diose sugars in the roots were the best indicator of the effects of fertilization on the soluble carbohydrates. Polysaccharoses, representing the insoluble or storage carbohydrates, were in greater concentration in the roots than in the tops. In general, the course of the changes in concentration for both roots and tops was upward throughout the growth periods studied, the rate of change being greater in the roots.

The plants receiving complete fertilizers had a higher level of soluble and insoluble carbohydrates in both tops and roots during the latter development stages than did unfertilized plants or those fertilized with nitrogen and phosphorus separately. Phosphorus alone tended to effect a higher level in the plant tops, while nitrogen alone did not consistently affect the soluble carbohydrates in either tops or roots, but did tend to effect a lower concentration of insoluble carbohydrates near the end of the season. Plant growth and yields of seed cotton were increased by fertilizer applications, the largest returns resulting from a 9-3-3 followed by a 3-9-3 fertilizer. These mixtures also produced the most cotton at the first picking, showing an early stimulating effect on growth and square and boll formation and resulting in earlier maturity. The greater carbohydrate content of the plants correlated with larger plant growth and larger yields. The total carbohydrate content expressed as percentage of green plant or as grams per plant was greatest in plants grown with these two fertilizers.

652. MAINTAINING THE PRODUCTIVITY OF IRRIGATED LANDS. By A. V. Lyon. (*Jour. of the Aust. Inst. of Agr. Sci.*, iii., **2**, 1937, p. 79.) Discusses the association of soil wastage with irrigation; the loss of productivity in irrigated lands; methods of agricultural drainage; general procedure in planning agricultural drains; control of irrigation waters.

653. SAW GINS: CARE AND MAINTENANCE. By C. A. Bennett and F. L. Gerdes. (*U.S. Dept. Agr. Circ. No.* 393, 1936. From *Summ. of Curr. Lit.*, xvii., **8**, 1937, p. 208.) Experiments on ginning with saws in good and bad condition, on various strains of cotton, are reported in detail. The difference in the monetary value of the lint was more than $2 per bale for cotton of 1⅛ inches staple and longer, and about $1 per bale for shorter cotton. Improvement in grade with good saws was accompanied by a larger yield, about 10 lb. more lint on 1,500 lb. of seed-cotton. The construction of gin saws is fully described, and directions are given for sharpening and setting them and for storage in the "off" season. The function, spacing and maintenance of gin ribs are also discussed.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

654. A MANUAL OF ENTOMOLOGICAL EQUIPMENT AND METHODS. By A. Peterson. Pt. I. (Edward Bros., Ann Arbor, Mich., 1934. Price $3.75. From *Rev. App. Ent.*, xxii., Ser. A, **11**, 1934, p. 632.) Includes discussions on field insectaries and on the influence of various environmental factors within cages and containers, but consists largely of original outline drawings of equipment, together with explanations and references to the publications in which they may be found. Miscellaneous tables and indices to authors and contributors and to the subject matter are appended.

Pt. II. (J. S. Swift Co., St. Louis, Mo., 1937. Price $4.50 plus postage. From *Rev. App. Ent.*, xxv., Ser. A., **6**, 1937, p. 346.) An attempt to give abstracts on all information in rearing insects (except bees and silkworms) appearing in papers published in English. Abstracts are also included of information on marking insects, transporting living insects and specimens, collection, and photography related to insects, together with notes on laboratory and museum methods. Illustrations of apparatus, and indices to scientific and popular names of insects, and to equipment and methods, are appended.

655. DATA ON PESTS AND DISEASES OF COTTON PLANTS. By M. I. Kosubutsky and I. N. Stepantsev. (Tashkent, 1935.) A collection of papers in Russian, with English summaries, dealing with the following: " Life History of the Cotton Red Spider " (A. A. Tibilova); " Comparative Tests on the Susceptibility of Different Cotton Varieties to the Attack of Red Spider " (K. O. Ter-Zakharyan); " Physiology of Cotton Plant attacked by Red Spider " (V. A. Bogolubova and O. N. Granitova); " *Laphygma exigua* Hb. and its Control under the Conditions of Central Asia " (P. P. Bogush); " Study of the Cotton Bollworm (*Chloridea obsoleta* F.) " (M. A. Sosnina); " Brief List of Cotton Insect Pests in Southern Tadjikistan " (M. A. Sosnina); " The Effect of Acacia Aphid (*Aphis laburni* Kal.) on the Development and Yield of Cotton " (I. N. Stepantsev); " The Mass Infection of Cotton Bolls in the Khorezin Oasis " (V. I. Serbinov).

656. THE INQUIRY ON THE EFFECTIVENESS OF THE SYSTEM OF MEASURES FOR CONTROL OF COTTON PESTS AND DISEASES. By A. K. Reddis. (*Summ. of Sci. Res. Work, Inst. of Pl. Prot.*, 1935. Leningrad, 1936. From *Rev. App. Ent.*, xv., Ser. A, **3**, 1937, p. 147.) Investigations in Central Asia indicated that the red spider spreads to cotton from weeds growing in and near the fields. Spraying the weeds with lime-sulphur or oil emulsions delays and reduces infestation of the cotton, and is much more effective in control of the pest than the removal and destruction of the weeds.

657. STUDY AND CONTROL OF INSECT PESTS. (*Misc. Pubn. Agr. Res. Bur. China*, **5**, Nanking, 1936. From *Rev. App. Ent.*, xv., Ser. A, **4**, 1937, p. 230.) Sprays of lead arsenate and of calcium arsenate, both at the rate of 2·4 lb. per 100 gals. water, gave 97·6 and 98 per cent. mortality, respectively, of larvæ of *Cosmophila* (*Anomis*) *flava*, F. on cotton. Lead arsenate at the rate of 7·4 lb. per 100 gals. killed 52 per cent. of the cotton leaf-roller, *Sylepta derogata*, F., but calcium arsenate at the rate of 6·4 lb. killed only 4 per cent.

658. COTTON PESTS IN FORMOSA. (In Japanese.) (*Bull. Res. Inst. Formosa*, **122**, Taihoku, Formosa, 1936. From *Rev. App. Ent.*, xxv., Ser. A, **4**, 1937, p. 228.) Of the 73 insects known to occur on cotton in Formosa, the more injurious include *Empoasca* (*Chlorita*) *biguttula*, Mats., *Dysdercus cingulatus*, F. (*megalopygus*, Breddin), *Aphis gossypii*, Glov., *Earias chromataria*, Wlk., *E. fabia*, Stoll, *Sylepta derogata*, F., and *Platyedra* (*Gelechia*) *gossypiella*, Saund. *E. biguttula* is the most serious pest. In the south part of the island, where it has thirteen generations a year, the eggs hatch in 6-28 days and the nymphal stage is completed in 7-8 days in summer and 24-25 in winter. The females lay their eggs singly in the stalks, leaf-veins or petioles 5-10 days after emergence and 2-5 days after pairing. On plants about 8 inches high, the eggs are generally laid in the ribs of the leaves, but on those that have reached a height of 20 inches they are generally found in the petioles and never in the stalks. The male adults live for about three weeks and the females for a few days longer. Infestation causes the leaves to curl and eventually drop, and reduces the crop. Varieties of cotton with leaves hairy on the under side are less injured than others. Effective control can be obtained by sprays of 2¼ lb. pyrethrum and 2¼ lb. soap in 100 gals. water, applied four times during the growing season; sprays of derris and soap have also given satisfactory results.

D. cingulatus causes considerable damage to cotton and also feeds on *Hibiscus*, sugar-cane, mango and other plants. It has six generations a year, the egg stage lasting 5-21 days and the nymphal stage 25-84. The eggs are laid in masses of about ninety in the soil, usually just below the surface, one female laying up to 4 masses. The adults are generally found on cotton after it has flowered; they attack the bolls, which are shed or fail to open. A species of *Lygæus* is predacious on this cotton stainer.

659. INSECTS INJURIOUS TO COTTON IN MANDATED SOUTH SEA ISLANDS OF JAPAN: FIRST REPORT. By T. Esaki. (In Japanese.) (*Kontyu*, **11**, Nos. 1-2, Tokyo, 1937. From *Rev. App. Ent.*, xxv., Ser. A, **6**, 1937, p. 335.) Very brief notes are given on the following insects attacking cotton: *Oxycarenus bicolor*, *Dysdercus cingulatus*, *D. philippinus*, *Aphis gossypii*, *Saissetia nigra*, *Ferrisiana virguta*, *Platyedra gossypiella*, and *Earias fabia*.

660. COTTON PESTS IN SOUTHERN RHODESIA, 1936. By R. W. Jack. (*Ann. Rpt. of Div. of Ent.*, 1936. From *Rhod. Agr. Jour.*, July, 1937, p. 570.) In a report by the Cotton Specialist it is stated that American bollworm damage was less than for the last few years, though in some areas crops were fairly heavily attacked. By regulating the time of planting of cotton and other crops, some alleviation of attack may be obtained. Red (Sudan) bollworm injury was slightly more than in the previous year. Investigations show the importance of prohibiting ratooning, and the leaving of cotton crops "stand-over" from one season to another, in limiting the spread of this pest. Stainer damage was heavier than during the previous year. Jassid damage was not serious except in one or two isolated areas, especially on part of the Cotton Station, Gatooma, where the attack was abnormally heavy. This emphasizes the importance of the new highly resistant strains of cotton which are being bred up at the Station.

661. MEMORANDUM ON PRECAUTIONARY MEASURES AGAINST THE INTRODUCTION OF THE COTTON BOLL WEEVIL INTO THE ISLANDS OF THE EASTERN WEST INDIES, AND RECOMMENDATIONS IN RESPECT OF THE ACTION TO BE TAKEN BY THE GOVERNMENTS OF ALL THE ISLANDS. By C. C. Skeete. The precautionary measures recommended include the issue of leaflets to prospective passengers from infected areas "setting forth a list of the articles the importation of which is prohibited, the restrictions to which the movements of ships will be subjected, and the treatment to which various classes of cargo and personal baggage will be subjected in respect of all ships, cargo, and baggage travelling from the infected areas to the non-infected areas." It is also recommended that the importation of the following, among other articles from an infected area, be prohibited: cotton seed, cotton seed hulls, cake and meal and other cotton seed products, seed-cotton, cotton lint and any part of the cotton plant.

662. RECENT ADVANCES IN THE CONTROL OF THE PINK BOLLWORM (*Platyedra gossypiella*, Saund.) BY NATURAL ENEMIES. By M. Kamal. (*Bull. Soc. R. Ent. Egypte*, xx., 1936, p. 269. From *Rev. App. Ent.*, xxv., Ser. A, **6**, 1937, p. 330.) An account of investigations now being carried out on the biological control of pink bollworm on cotton in Egypt, where it does damage to the value of £6,000,000 annually. The possibility of intensifying the activity of indigenous parasites, chiefly *Pimpla roborator* F. and *Microbracon brevicornis* Wesm., by breeding was examined in three successive years, without, however, any permanent adjustment being obtained between host and parasite, although the kill of the host was increased by bringing the parasites into the field early. ***Elasmus platyedræ*** Ferriere, ***Habrocytus*** sp., *Dibrachys* sp., and ***Pleurotropis*** sp. are beneficial in the spring and early summer. Parasites were also imported, *Microbracon kirkpatricki* from Kenya, *M. mellitor* from Hawaii, and *M. lefroyi* from the Punjab. *M. mellitor* breeds readily and may become established, and *M. lefroyi* has been found to attack pink bollworm. Attempts made over five years to establish *M. kirkpatricki* have not as yet given satisfactory results.

663. THE INFLUENCE ON THE CONTROL OF *Platyedra* (*Pectinophora*) *gossypiella*, SAUND. OF DESTROYING THE INFESTED FLOWERS. By C. Hsu. (In Chinese.) (*Ent. and Phytopath.*, iv., **32**, Hangchow, 1936. From *Rev. App. Ent.*, xxv., Ser. A, **6**, 1937, p. 382.) The author considers that the destruction of cotton flowers infested with pink bollworm is of value in its control, and briefly discusses the way in which the work should be carried out.

664. THE INCIDENCE OF *Platyedra gossypiella* AND *Dysdercus* SPP. AND VARIOUS CRYPTOGAMIC DISEASES IN COTTON BOLLS DURING JUNE, 1936. By H. P. Krug and L. O. T. Mendes. (In Portuguese, with English summary.) (*Bol. Techn. Inst. Agron. Campinas*, No. 25, 1936. From *Rev. App. Ent.*, xxv., Ser. A, **6**, 1937, p. 378.) The results are given of a detailed examination of 349 cotton bolls in Campinas, Brazil, made in June, 1936, to ascertain the damage caused by insects, fungi and bacteria.

665. IL "VERME ROSA" DEL COTONE IN ITALIA. By G. Trinchieri. (*Bull. Soc. Ent. Ital.*, 68, **9-10**, Genoa, 1936. From *Rev. App. Ent.*, xv., Ser. A, **5**, **1937**, p. 285.) In a recent paper Li Feng-swen included Italy among the countries in which *Platyedra gossypiella*, Saund. occurs. The author was not aware of its presence there, but found on enquiry that it has been recorded as infesting over 50 per cent. of the cotton bolls in Sicily, where it was first observed in 1927.

666. POPULATION DENSITY, HABITS AND RATE OF GROWTH OF *Gelechia gossypiella*, SAUND. DURING THE COTTON CULTIVATING PERIOD. By M. Eguti. (In Japanese.) (*Ann. Agr. Exp. Sta. Chosen*, viii., **4**, Korea, 1936. From *Rev. App. Ent.*, xxv., Ser. A, **4**, 1937, p. 230.) In Korea, infestation of cotton by *Platyedra* (*Gelechia*) *gossypiella*, Saund. is more severe in fields near places where the crop is stored or dried than in outlying fields. In the former, the numbers of eggs decreased from July to August and then increased, reaching a maximum in early September and October, when 1,700 were found per acre in 1934, and 2,000 in 1935. The eggs were deposited on the basal parts of the bolls and the buds, as well as on the under surface of the leaves, and, when the insects were abundant, on the stalks. The larvæ were most abundant just before harvest in late September and October, when over 6,000 sometimes occurred per acre.

667. INVESTIGATION OF *Platyedra gossypiella* (PINK BOLLWORM) IN UGANDA. By T. H. C. Taylor. (*Ann. Rpt. Dpt. of Agr. Uganda*, 1936.) A summary is given of the history and present distribution of pink bollworm in Uganda. The life cycle of the pest has been studied, and the various respects in which its habits differ from those recorded in other countries are discussed. Experiments on the resting stage indicate that this does not affect the degree of infestation, and is never likely to be a factor of primary importance in Uganda in normal or in abnormally wet seasons. Many natural factors operating in the country exercise a high degree of control over the pest, and injury to the cotton crop on the whole is small. The best methods of control suggested are the rigid enforcement of a close season and the cultivation of more rapidly maturing varieties of cotton.

668. ENGINEERING PHASES OF PINK BOLLWORM CONTROL. By D. A. Isler. (*Agr. Eng.*, **17**, No. 8, 1936. From *Exp. Sta. Rec.*, 76, **5**, 1937, p. 702.) In a brief contribution from the U.S.D.A. Bureau of Agricultural Engineering it is pointed out that the engineering phases of present investigations for effective field control of the pink bollworm include (1) development of mechanical equipment for the destruction of worms in the crop remnants, and (2) determining the value of ploughing, irrigation, and other cultural practices as control measures.

669. Improved Device for Artificial Feeding of Aphids. By D. J. Pletsch. (*J. Econ. Ent.*, xxx., **1**, 1937, p. 211.) An apparatus composed of glass cages constructed from test tubes is described.

670. Coloured Insecticides for Aphids. (*Sci. American*, 1937. From *Madras Agr. J.*, xxv., **6**, 1937, p. 188.) Experiments indicated that aphids were attracted to plants sprayed with Bordeaux mixture because of increased intensity of light reflected from the sprayed surfaces. Spraying of black-coloured mixtures was found to be effective in reducing the infestation.

671. Toxicity of Selenium-Containing Plants to Aphids. By A. M. Hurd-Karrer and F. W. Poos. (*Sci.*, 84, **2176**, 1936. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 829.) Experiments have shown that the apple grain aphid is sensitive to concentrations of selenium in wheat plants. Aphids placed on two-month-old plants supplied with concentrations of selenium greater than 3 p.p.m. all died within a few days, while those with lower concentrations lived for as long as a week, although without reproducing actively. Similar results were observed with the common red spider. The plants were stunted by concentrations greater than 3 p.p.m. of selenium. Comparatively few aphids survived on one-month-old plants grown with but 1 p.p.m. of selenium, although some reproduction did take place. For some reason more of the aphids persisted on rye plants than on wheat, oats, and barley grown in soil treated with sodium selenate at the rate of 10 p.p.m. of selenium, although the number was greatly reduced.

[*Cf.* article by Mason and Phillis, and Abstrs. **637**, **638**, in this issue.]

672. A Lagarta das Macas do Algodoeiro, *Chloridea virescens* Fab. By L. O. T. Mendes. (*Bol. Tech. No.* 28, Inst. Agr. de Campinas, Brazil, 1837.) *Chloridea virescens* Fab. has been recorded as attacking cotton in Sao Paulo. The buds and squares are often completely destroyed, and one to three locks in the bolls are damaged. A brief account is given of the life history and habits of the pest. Spraying with lead arsenate is recommended as a control.

673. Cotton Flea Hopper Control Tests. By J. C. Gaines. (*J. Econ. Ent.*, 30, **1**, 1937, p. 119.) This paper deals with the Latin square method of plat arrangement for comparing materials used in control studies of cotton flea hopper, *Psallus seriatus*, Reut. The purpose of the investigations described was twofold: first, to find out if this plat or block arrangement, using small blocks, could be used in cotton-dusting control experiments, and, second, to find out which material gave the best control of cotton flea hopper nymphs.

674. Large-Scale Sulphur-Dusting Experiments for Cotton Flea Hopper Control at Port Lavaca, Texas. By K. P. Ewing and R. L. McGarr. (*J. Econ. Ent.*, xxx., **1**, 1937, p. 130.) Two to four effective applications of sulphur were made on fields of cotton ranging in size from 17·5 to 76 acres, the average amount of sulphur used being 62·1 lb. per acre. Average gain in production from the sulphur dusting was 165·5 lb. of seed-cotton per acre, showing an average net profit of $4.75 per acre.

675. Recent Insecticide Experiments to Control Cotton Flea Hopper at Port Lavaca, Texas. By K. P. Ewing and R. L. McGarr. (*J. Econ. Ent.*, xxx., **1**, 1937, p. 125.) In cage tests, derris root, cubé root, mixtures containing rotenone, and phenothiazine were ineffective in killing cotton flea hopper. Pyrethrum dust containing 5 per cent. total pyrethrins was effective in killing adults (75 per cent.), and fairly effective against nymphs (57·7 per cent.). Mixing pyrethrum with sulphur increased the kill of nymphs but decreased the kill of adults. A mixture of 10 per cent. Paris green and 90 per cent. sulphur gave the best control of the insect in field tests in 1935.

676. THE PREVALENCE OF THE COTTON GEOMETRID IN HAIMEN, KIANGSU. By S. Chou. (*Ent. and Phytopath.*, 4, **24**, Hangchow, 1936. From *Rev. App. Ent.*, xv., Ser. A, **3**, 1937, p. 198.) Cotton in a large area in South Kiangsu is severely infested by Geometrid larvæ that in May occur at the rate of 23 per square foot. Observations of 20 adults in the field showed that each female can lay over 1,000 eggs, more than 95 per cent. of which hatch. Hand-collection of the larvæ appears the most successful method of control.

677. THE CORN EARWORM. By L. P. Ditman and E. N. Cory. (*Maryland Sta. Bull.* 399, 1936. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 831.) In this report of studies of the corn earworm (*Heliothis obsoleta*) the authors consider the genera trend of infestation and report upon varietal resistance, poison bait traps, the response of earworm moths to sugars, moth poisons, and poison traps or feeders, and insecticide tests, the details of the work being presented in tables and graphs.

[*Cf.* Abstrs. **178**, Vol. IX., **427**, Vol. X., **432**, Vol. XI. of this Review.]

678. STUDY ON CONTROL MEASURES AGAINST *Chloridea obsoleta*. By A. E. Robb. (*Summ. of Sci. Res. Work, Inst. of Pl. Prot.*, 1935. Leningrad, 1936. From *Rev. App. Ent.*, xv., Ser. A, **3**, 1937, p. 146.) In field tests against the larvæ of *Heliothis armigera*, Hb. (*Chloridea obsoleta*, F.) on tomatoes and cotton in Uzbekistan, poisoned baits of ground oilcake were more effective than various dusts. On cotton, 100 and 81·4 per cent. respectively of the larvæ were killed by baits containing 6·2 and 5 per cent. calcium arsenate used at the rate of 36 lb. per acre.

679. AN INVESTIGATION ON THE RÔLE OF PARASITES OF EGGS AND LARVÆ OF *Chloridea obsoleta*. By A. E. Robb. (*Summ. of Sci. Res. Work, Inst. of Pl. Prot.*, 1935. Leningrad, 1936. From *Rev. App. Ent.*, xv., Ser. A, **5**, 1937, p. 146.) A great decrease in the numbers of the fourth generation of the bollworm *Heliothis armigera* (*Chloridea obsoleta*), in Taskhent in 1935, was caused by an unidentified egg parasite, which destroyed 68·2 per cent. of the eggs. Under experimental conditions, a female was capable of parasitizing up to 15 eggs of the bollworm in twenty-four hours, and deposited 1-7 eggs (all of which developed) in each egg of the host. The adults, which lived up to 34 days when given sugar-syrup, also fed on the fluid contents of the eggs of the bollworm. In August, the life-cycle was completed in 11-15 days. Hibernation occurred in the host eggs. The larvæ of *H. armigera* were parasitized by an unidentified Braconid, which destroyed 12·2 per cent. of the second and 94·4 per cent. of the third generation. It oviposited in larvæ of the first and second instars, usually laying one egg in each, and the parasites emerged when the host larvæ were almost full-fed, and immediately spun cocoons on the leaves. Hibernation occurred in the cocoon. In the insectary the females of the parasite lived up to 14 days and parasitized up to 11 larvæ a day. In south-western Turkmenistan *H. armigera* was largely controlled by *Microbracon* (*Habrobracon*) *simonovi*, Kok.

680. REACTION OF CORN EARWORM MOTH AND OTHER INSECTS TO LIGHT TRAPS. By L. A. Carruth and T. W. Kerr. (*J. Econ. Ent.*, xxx., **2**, 1937, p. 297.) The 25-watt and 60-watt mercury vapour light traps used attracted more corn earworm moths than did a 75-watt tungsten light trap; fewer females were caught than males. It may be questioned whether any of the traps used were really effective in attracting female moths of the corn earworm.

681. OBSERVATIONS ON POISON BAITS FOR CORN EARWORM CONTROL. By L. P. Ditman. (*J. Econ. Ent.*, 30, **1**, 1937, p. 116.) The results of investigations indicate that (1) sucrose is the most attractive of the more common sugars, and a concentrated bait of sucrose is superior to a fermenting bait; (2) sodium arsenate appears to be the fastest acting of the soluble insecticides; (3) moths hesitate to take such organic poisons as pyrethrum and nicotine.

682. A NEW EUMOLPID PEST OF COTTON. By A. da Costa Lima. (In Portuguese.) (*Campo,* vii., 83. Rio de Janeiro, 1936. From *Rev. App. Ent.,* xv., Ser. A, **4,** 1937, p. 232.) A description of *Melinophora inglesiasi,* sp. n., adults of which have recently been found attacking the leaves of cotton in various parts of Brazil. The same Eumolpid was recorded as *Colaspis* sp. in a report published by F. Inglesias in 1915, which is reprinted. He stated that the adults cause serious injury to cotton and also attack mango, guava and other plants.

683. BIONOMICS AND ECOLOGY OF THE MOROCCAN LOCUST IN MIDDLE ASIA. By E. N. Ivanov. (*Summ. of Sci. Res. Work, Inst. of Pl. Prot.,* 1935. Leningrad, 1936. Abstr. in *Rev. App. Ent.,* xv., Ser. A, **3,** 1937, p. 147.)

684. STUDIES ON *Schistocerca gregaria,* FORSK. By C. B. Mathur and B. N. Soni. (*Ind. J. Agr. Sci.,* vii., **2,** 1937, p. 317.) IX. "Some Observations on the Histology of the Blood of the Desert Locust."

[*Cf.* Abstrs. **111** and **296,** Vol. XIV. of this Review.]

685. CONTROL OF *Epitetranychus althϾ.* By I. N. Stepantzev. (In Russian, with a summary in English.) (*Sotzial. Nauk. Tekh.,* iv., **7,** Tashkent, 1936. From *Rev. App. Ent.,* xv., Ser. A, **5,** 1937, p. 311.) A formula for the probable infestation of red spider, *Tetranychus telarius,* L. (*Epitetranychus althϾ,* v. Hanst.), in a given year, is worked out from various data, and a further formula to estimate the area of infestation.

686. THE EXAMINATION OF TECHNICAL EFFECTIVENESS OF SULPHUR PREPARATIONS FOR CONTROL AGAINST COBWEB-MITE (RED SPIDER) IN DIFFERENT GEOGRAPHICAL POINTS. By L. K. Limoenkov. TECHNICAL EFFECTIVENESS OF SULPHUR PREPARATIONS AGAINST COBWEB-MITE (RED SPIDER). By — Nikolyuk. (*Summ. of Sci. Res. Work, Inst. of Pl. Prot.,* 1935. Leningrad, 1936. From *Rev. App. Ent.,* xv., Ser. A, **3,** 1937, p. 147.) These two papers deal with field tests of various sulphur dusts against the red spider (*Tetranychus* sp.) on cotton in Central Asia. In both series the most effective was ground sulphur mixed with talc, when the temperature was not below 25° C. (77° F.).

687. CONTRIBUTIONS ON TERMITE CONTROL. (*J. Econ. Ent.,* xxx., **1,** 1937, pp. 87, 92, 94.) "Problems in Termite Control," D. M. Muirhead; "Relation of State Workers to Commercial Termite Control Companies," N. Turner; "Termite Control in North-eastern United States," G. E. Sanders.

688. THE HARVESTER TERMITE. By W. G. H. Coaton. (*Farmg. in S. Afr.,* xii., **135,** 1937, p. 249.) A brief illustrated account of the biology and economic importance of the pest in South Africa. The control suggested is a poison bait consisting of grass cut into small pieces of half an inch long, soaked for a few minutes in a solution of 1 lb. sodium arsenite, 8 lb. brown sugar and 8 gallons water. The bait should be dried and stored in bags ready for use when required.

689. ECOLOGO-ECONOMIC BASIS AND DEVELOPMENT OF A SYSTEM OF CONTROL MEASURES AGAINST PESTS AND DISEASES IN THE ESTABLISHED COTTON-GROWING DISTRICTS, UZBEKISTAN. By V. V. Nikol'skii *et al.* (*Summ. of Sci. Res. Work, Inst. of Pl. Prot.,* 1935. Leningrad, 1936. From *Rev. App. Ent.,* xv., Ser. A, **3,** 1937, p. 146.) A systematic study in the district revealed that the mite occurring on cotton recorded as *Tetranychus telarius* is an undescribed species of *Tetranychus* (*Eutetranychus*). The characters distinguishing it from allied mites are indicated. A mortality of 79·82·5 per cent. was obtained by spraying cotton and weeds with lime-sulphur (0·5° Bé.), provided that the temperature was not below 25° C. (77° F.), and all mites were killed on weeds surrounding the cotton fields by the application of alkali residues from the manufacture of soap.

690. *L'Apanteles sagax* WILKN. PARASITE DE LA PYRALE DU COTONNIER. By H. de Saeger. (*Bull. Agr. du Congo Belge*, xxviii., **1**, 1937, p. 147.) A description with the life history of *Apanteles sagax*, a Braconid widely distributed in Belgian Congo, where it has proved to be a useful parasite of *Sylepta derogata* (leaf roller).

691. EXPERIMENTAL STUDIES IN INSECT PARASITISM. IV. THE EFFECT OF SUPER-PARASITISM ON POPULATIONS OF *Trichogramma evanescens*. By G. Salt. (*Jour. Exp. Biol.*, 13, **3**, 1936. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 833.) *Trichogramma evanescens* was found able to distinguish healthy from parasitized hosts, and when few hosts were available to restrain itself for eight hours with a deposition of 5 per cent. of its available eggs.

692. ANNOTATED HOST LIST OF UGANDA PARASITIC FUNGI AND PLANT DISEASES. Pts. I. and II. By C. G. Hansford. (*E. Afr. Agr. Jour.*, ii., **5-6**, 1937, pp. 419 and 498.) A useful list compiled under the names of the plants attacked, which are arranged in systematic order.

693. SOME EFFECTS OF PLANT DISEASES ON VARIABILITY OF YIELDS. By C. Hartley and A. Rathbun-Gravatt. (*Phytopathology*, xxvii., **2**, 1937, p. 159. From *Rev. App. Mycol.*, xvi., **7**, 1937, p. 479.) Two groups of diseases differing markedly in their effects on yield variation may be distinguished, one including those promoted by conditions weakening the host, which tend strongly to enhance the annual yield variations, and the other comprising disorders favoured by factors that simultaneously stimulate host growth. Representatives of the former group are probably most numerous among the root rots and vascular diseases—*e.g.*, *Fusarium* wilt of cotton—while a striking example of the latter is furnished by late blight of potatoes (*Phytophthora infestans*), which has been reduced from a source of disastrously heavy losses to an apparently stabilizing factor, as far as regional and national (not necessarily individual) yields are concerned, by the application of standard schedules of control.

694. L'IMMUNITÉ AUX MALADIES BACTÉRIENNES DES PLANTES. By T. Savulescu. (Pubd. in France by Imprimerie Soulisse-Martin, Niort, 1936. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 380.) The problem is discussed under the headings (*a*) resistance of plants to bacterial diseases, which includes mechanical resistance and physiological resistance; the inheritance of resistance is briefly treated in the last section; (*b*) the acquired immunity of plants to bacterial diseases, which includes acquired immunity to superinfection, vaccinal immunity, serological immunity, anaphylaxis, and immunity in plants and bacteriophages.

695. COTTON DISEASES IN EGYPT. By T. Fahmy. (*Int. Cott. Bull.*, xv., **59**, 1937, p. 396.) Three diseases attack cotton in Egypt, sore shin, wilt, and angular leafspot, but only wilt is of importance. The best method of control is by growing immune varieties of cotton, and the Botanical Section have evolved many highly-resistant varieties, including the Giza strains. By the selection of immune cottons it has been possible to control a disease which was causing a loss of not less than £E.100,000 annually.

696. COTTON DISEASES IN NORTH CAROLINA DURING THE SEASON OF 1936. By L. Shaw. (*Plant Dis. Reptr.*, xx., **22**, 1936. From *Rev. App. Mycol.*, xvi., **5**, 1937, p. 314.) The treatment of cotton seed against damping-off (chiefly *Glomerilla gossypii* and *Corticium solani*) on 67 farms in North Carolina in 1936 with 2 per cent. ceresan reduced the average percentages of infection and death from 78 to 10 and 9 to 1 respectively, increased the average numbers of plants emerging and standing at picking time per 100 ft. of row from 248 to 416 and from 106 to 137 respectively, and augmented the average yield and value of lint and seed per acre from 1,295 to 1,548 lb. and from $68.36 to $81.71 respectively. Using these figures as a basis, it computed that on the 891,000 acres planted with untreated seed in the State during 1936 damping-off caused a reduction in yield of some 133,650,000 lb. of seed cotton, valued at about $7,056,720. Notes are also given on three other cotton diseases.

697. ON THE PROBLEM OF THE NATURE OF THE ACTION OF BACTERIORHIZAL MICRO-ORGANISMS ON PLANTS. By A. A. Isakova. (*C. R. Acad. Sci. U.S.S.R.*, N.S., iv., **9**, 1936. From *Rev. App. Mycol.*, xvi., **5**, 1937, p. 334.) A tabulated account is given of experiments in which the action was studied of bacterial suspensions obtained from bacteriorhiza of cotton, wheat, tobacco, beans, and from a soil mixture, on the germination of cotton, Indian tobacco, and wheat seeds. When seeds of cotton were sprinkled with the suspensions, the germination was most accelerated by the cotton bacteriorhiza which, on the third day from sowing, increased the number of seedlings by 56 per cent., the bacteriorhiza from a soil mixture coming next, with an increase of 52 per cent.

698. THE NEW FUNGUS NAMES PROPOSED BY C. G. LLOYD. By J. A. Stevenson and E. K. Cash. (*Bull. Lloyd Libr.* 35, Mycol. Ser., **8**, 1936. From *Rev. App. Mycol.*, xvi., **5**, 1937, p. 341.) This is an annotated list with citations of 56 genera, 1,094 species, and 38 varieties or forms named as new by the late C. G. Lloyd, together with 392 species transferred by him to other genera. A further genus and 7 species omitted are listed on a mimeographed slip.

699. THE SOIL-BORNE FUNGUS DISEASES OF FIELD AND PLANTATION CROPS. By S. D. Garrett. (*Emp. Jour. of Exp. Agr.*, v., **19**, 1937, p. 189.) A review of existing control methods.

700. NOTAS SOBRE ALGUNAS ENFERMEDADES DEL ALGODONERO. By G. L. Fawcett. (*Circ. Estac. Exp. Agr. Tucuman*, **52**, 1936. From *Rev. App. Mycol.*, xvi., **5**, 1937, p. 315.) Popular notes are given on *Bacterium malvacearum*, *Cercospora gossypina*, and two forms of root rot affecting cotton in the Argentine, one caused by an undetermined Hymenomycete with white hyphæ furnished with clamp-connections, and the other by a *Rhizoctonia* forming a typical chestnut or purple layer over the invaded areas. None of the diseases is of much economic importance under local conditions.

701. INVASION OF COTTON SEED BY *Bacterium malvacearum*. By G. Tennyson. (*Phytopathology*, xxvi., **11**, 1936. From *Rev. App. Mycol.*, xvi., **4**, 1937, p. 248.) Under favourable conditions of moisture 20 per cent. or more of cotton seedlings become infected with *Bacterium malvacearum* as a result of internal contamination of the seed. Evidence is briefly adduced from laboratory tests to show that the organism can enter untreated and delinted cotton seed through the basal cap in the presence of water. The cap is composed of pigment-bearing cells with large intercellular spaces, and sections of inoculated seed showed the bacteria beneath the basal cap and in the spaces. Under natural conditions innumerable bacteria are washed to the ground from the infected foliage and remain suspended in the run-off water between the rows of cotton, where they can maintain their viability for 44 to 56 hours. The seed of open bolls soaked in bacterium-laden water has been experimentally shown to carry both internal and external contamination. On entering the mature seed the organisms apparently become inactive and remain so until germination commences. The basal cap, adhering to the cotyledons, is carried upwards as the plant emerges from the soil. The soil water may convey the bacteria to the seed leaves and hypocotyl, or they may be washed by rain or dew on to the leaves and stems, thus inducing primary seedling infection.

702. Investigations on Blackarm Disease of Cotton under Field Conditions. II. The Effect of Flooding Infective Cotton Debris. By F. W. Andrews. (*Emp. Jour. of Exp. Agr.*, v., **19**, 1937, p. 204.) A description is given of an experiment on the Gezira Research Farm where blackarm infected cotton debris was flooded for varying periods of time. The results obtained show conclusively the killing power of canal water on blackarm infected cotton debris on the ground. The application of these flooding measures on a large scale to a portion of the irrigated cotton land of the Gezira is then described. The flooding of the old cotton land has resulted in the absence of the usual concentration of the disease on the side of the new cotton howasha (10-acre plot) nearest this old land, and has left only a light scatter infection through the howasha. Evidence is given for assuming that this localized concentration is due, in particular, to the carry by rainstorms of the infection from volunteer infected cotton seedlings appearing in the old cotton land. The final results obtained, though not, as might be expected, so striking as those described in Pt. I., are yet sufficiently conclusive to warrant the application of this control measure, combined with a later sowing-date, in small areas of intense infection.

[*Cf.* Abstr. **124**, Vol. XIV. of this Review.]

703. Gummosis of Cotton: Materials for the Elaboration of a System of Control Measures. By D. D. Verderevska, O. P. Lebedeva *et al.* (In Russian, with English summaries.) (*Publ. Transcauc. Sci. Res. Inst. Cotton, Sci. Ser.*, Tiflis, 1935. From *Rev. App. Mycol.*, xvi., **3**, 1937, p. 171.) In this collection of papers a brief historical, biological, and morphological account is first given of the blackarm or gummosis disease (*Bacterium malvacearum*) of cotton, together with a summary of the results of investigations in 1933-1934 on the etiology and control of the disease in Transcaucasia and Armenia. Laboratory experiments showed that immersion of cotton seed for from 5 to 15 minutes in formalin (1 in 100), followed by covering for 2 hours, completely controlled surface infection of the seed, without unduly interfering with the germinability, while treatment of the seed with sulphuric acid did not entirely destroy the parasite. In field plots raised from formalin-treated seed infection was about half that present in control plots, while in plots raised from seed treated with sulphuric acid it was reduced only by some 30 per cent.

In the last paper, Lebedeva states that *Bacterium malvacearum* was obtained in pure culture in both years from aseptically dissected pieces of cotton seeds (exclusively from badly infected bolls) that had been delinted for 30 minutes in sulphuric acid of 1·8 sp. g., after which they were immersed in a 0·1 per cent. mercuric chloride solution for 10 minutes and then washed four times in sterile tap water, thus demonstrating internal infection of the seeds by the organism. The bacterium was never isolated, however, from seed collected from infected plants, unless the lint showed visible signs of infection. There was evidence that it was only present in the fleshy portions of the seed, and it is suggested that invasion takes place from the infected lint before the hardening of the seed-coat. Internal infection was found in practically all the seeds from infected bolls that were examined, but it is not believed to play an important part in the dissemination of the disease owing to the fact that badly diseased bolls are generally excluded at the harvest. There was evidence also that less than 50 per cent. of such seeds germinated after sowing, and isolations from the seeds that failed to mature indicated that they mostly contained only the saprophytic yellow bacterium which frequently accompanies *B. malvacearum* and *Alternaria tenuis*.

704. Contribution to the Knowledge of Cotton Gummosis and to its Control in Transcaucasia. By A. A. Babayan *et al.* (In Russian, with English summary.) (*Publ. Transcauc. Sci. Res. Inst. Cotton, Sci. Ser.*, Tiflis,

1935. From *Rev. App. Mycol.*, xvi., **3**, 1937, p. 172.) A concise, tabulated account of the investigations carried out up to the end of 1933 in Armenia and partly also in Azerbaijan on the biology and control of blackarm disease of cotton. It was shown, *inter alia*, that the causal organism in pure culture withstood constant freezing, with occasional falls of temperature as low as 27·8° C. for a whole month in 1933, but died out during the subsequent three or four weeks, when periods of freezing alternated with warmer spells, during which the thermometer showed temperatures up to 10·6°. In infected cotton leaves the bacterium survived two months when buried under snow, but was killed within a month when periods of thawing alternated with frosts. In one series of tests pieces of infected cotton plants were buried in soil in pots, and exposed to outdoor winter conditions, but no infection resulted when disinfected cotton seed was sown in pots at the end of the spring. In another series of experiments it was shown that *Bacterium malvacearum* on naturally infected cotton seed withstands a temperature of 90° C. for 5 hours in a dry, and for not less than 1 hour in a damp, atmosphere, while in pure culture it was killed within 20 minutes at 50° and within 10 minutes at 56°.

Delinting the cotton seed with sulphuric acid gave almost complete control of the disease in 1933, and secondary field infection of the seedlings raised from the treated seed was very limited. Seed disinfection of the seed with 1 in 100 formalin is also recommended because of its efficacy, cheapness, and ease of application. The incidence of the disease was markedly increased by poor tillage of the soil, belated thinning out of the cotton stands, and too late flooding. Egyptian and American Upland cotton varieties transplanted from hotbeds were significantly less susceptible to the disease than plants grown in the field.

705. Results of Experiments on Gummosis of Cotton in the Sabir-Abad Region of Azerbaijan. By R. Djelaloff. (In Russian, with English summary.) (*Azerbaijan Cotton Sci. Res. Inst.* [*AzNIKhI*], *Kirovabad, Sci. Ser.* 14, 1936. From *Rev. App. Mycol.*, xvi., **6**, 1937, p. 379.) A very fully tabulated account of experiments in 1934 in Azerbaijan on the control of *Bacterium malvacearum* on cotton. Field observations showed that infection was greater on soils sown to cotton for three consecutive years, indicating that the organism survives the winter under local conditions. Steeping non-delinted seed for 5 minutes in 1 in 100 formalin and covering it with tarpaulins for two hours reduced the incidence of the blackarm symptoms from 27·0 per cent. in the control to 15·5 per cent., compared with 22·1 per cent. for treatment with sulphuric acid (1·7 to 1·8 sp. g. for 15 minutes), and the incidence of angular leaf symptoms from 26·3 to 18·1 and 21·1 per cent. respectively, the corresponding index figures for intensity of infection (scale, 0, 0·1, 1, 2, 3 and 4) being 7·3, 3·3, 5·5, 2·7, 2·5 and 1·4 respectively. Sulphuric acid treatment accelerated somewhat the germination of the cotton seed, and apparently stimulated the vigour of the young seedlings, but this effect wore off as the season advanced.

706. La Nature de la Résistance du Coton au *Macrophomina phaseoli* (Maubl.) Ashby. By J. A. Sarejanni and C. B. Cortzas. (Reprinted from *C.R. IIIième Congr. Int. Path. Comp.*, 1936. From *Rev. App. Mycol.*, xvi., **4**, 1937, p. 249.) To ascertain whether the susceptibility of the Greek cotton variety Dodiotico (*Gossypium herbaceum*) to *Macrophomina phaseoli* and the resistance of American varieties to the same fungus are due to different anatomical characters the authors made a histological examination of the tap-roots of pot seedlings of the different cottons grown in Greece. These showed that in Dodiotico cotton the cortical phelloderm of the tap-root consists of 5 to 8 layers of nearly square cells averaging 25 to 28 by 15 to 25μ, while in the King, Acala, Trice, and Ingold varieties it consists of 8 to 12, 10 to 12, 10 to 15, and 22 layers respectively of rectangular cells measuring 50 to 72 by 25 to 30μ. Further, the suberized membrane averaged 1·5, 2·5, and 4·5μ thick in the Dodiotico, Acala, and King varieties respectively.

The available evidence indicated that the fungus effects entry through cracks in the phelloderm. Observation showed that most infection occurs locally in argillaceous soils which crack during hot weather and cause injuries to the Dodiotico roots. The phelloderm of the American cottons being stronger, these are naturally less susceptible.

707. PENETRATION AND INVASION OF *Phymatotrichum omnivorum* IN COTTON ROOTS GROWN UNDER PURE CULTURE CONDITIONS. By G. M. Watkins. (Abs. in *Phytopathology*, xxvii., **2**, 1937, p. 143. From *Rev. App. Mycol.*, xvi., **7**, 1937, p. 454.) Sections through cotton seedling roots grown in nutrient agar and inoculated with a pure culture of *Phymatotrichum omnivorum* showed that individual hyphæ of the mycelial weft may penetrate the epidermal cell wall or root hairs. From the epidermis they grow through and between the cortical cells and finally invade the endodermis and enter the stele, where longitudinal progression has been observed in the various tissues of the vascular cylinder. The infected cells are ultimately killed, and in the later stages are almost entirely filled with hyphæ. The penetration of the host cells may be accomplished by means of constricted hyphal tips, but definitely organized haustoria were not observed.

708. DISTRIBUTION AND PREVALENCE OF OZONIUM ROOT-ROT IN THE SHELTER BELT ZONE OF TEXAS. By G. L. Peltier. (*Phytopathology*, xxvii., **2**, 1937, p. 145. From *Rev. App. Mycol.*, xvi., **7**, 1937, p. 454.) The areas within the shelter belt zone of southern Oklahoma and Texas infested by root-rot (*Ozonium* [*Phymatotrichum*] *omnivorum*) were mapped out with a view to their avoidance for the cultivation of susceptible crops, such as cotton. Susceptible plants were used as indicators of infested territory, and the universal distribution of three susceptible weeds—*Solanum eleagnifolium*, *Ambrosia* spp., and *Chenopodium album*—in virgin, pasture, waste, and cultivated lands, was of material assistance in the detection of the fungus, useful indications as to the presence of which were further afforded by *Xanthium* spp., *Physalis* spp., *Helianthus* spp., and *Cirsium* spp. A section of land was deemed to be infested when the characteristic mycelial weft was observed on one or more diseased plants, or when conidial mats were found. A list is given of some resistant trees and shrubs recommended for planting in the affected sections.

709. COTTON ROOT-ROT AND WEEDS IN NATIVE HAY MEADOWS OF CENTRAL TEXAS. By C. H. Rogers. (*J. Amer. Soc. Agron.*, xxviii., **10**, 1936. From *Rev. App. Mycol.*, xvi., **3**, 1937, p. 176.) The root-rot fungus, *Phymatotrichum omnivorum*, is stated to have been repeatedly found destroying plants in undisturbed blackland prairies. Of a total of 47 plant species present in the meadow, 37 were more or less susceptible to *P. omnivorum*. The maintenance of meadows and pastures free of weeds is recommended as a means of starving out the root-rot fungus.

710. CONCENTRATION OF AMMONIA NECESSARY IN A LOW-LIME PHASE OF HOUSTON CLAY SOIL TO KILL THE COTTON ROOT-ROT FUNGUS, *Phymatotrichum omnivorum*. By D. C. Neal and E. R. Collins. (*Phytopathology*, xxvi., **10**, 1936. From *Rev. App. Mycol.*, xvi., **3**, 1937, p. 176.) The results of tests indicated that the effective initial concentration of ammonia in the soil lies in the range of 900 to 1,025 p.p.m. —a marked contrast to the low strengths required for the destruction of the mycelium and sclerotia of the fungus (50 and 300 p.p.m. respectively) in Erlenmeyer flasks.

711. STUDIES ON THE ROOT-ROT DISEASE OF COTTON IN THE PUNJAB. III. THE EFFECT OF SOME PHYSICAL AND CHEMICAL FACTORS ON SCLEROTIA FORMATION. By R. S. Vasudeva. (*Ind. J. Agr. Sci.*, vii., **2**, 1937, p. 259.) Experiments conducted to determine the conditions for the formation of sclerotia of *Rhizoctonia bataticola* and *R. solani* show that the intensity of sclerotia formation depends on the concentration, depth, and the pH value of the medium. The importance of sugar, nitrogen and phosphatic constituents on the sclerotia formation has also been explained. The nutrient media containing ammonium salts have a toxic effect on the growth of the fungi studied. Dilute solutions of mercuric chloride, copper sulphate and phenol are quite effective in checking the growth of *Rhizoctonia bataticola* and *R. solani.* Hydrocyanic acid gas penetrates in the soil to a depth of 18 inches, and kills the resting bodies of the fungi.

[*Cf.* Abstr. **307**, Vol. XIII., and **127**, Vol. XIV. of this Review.]

712. DISEASES OF COTTON IN THE PHILIPPINES: I. SCLEROTIUM STEM ROT, WITH NOTES ON OTHER DISEASES. By M. S. Celino. (*Philipp. Agr.*, xxv., **4**, 1936. From *Rev. App. Mycol.*, xvi., **2**, 1937, p. 95.) In 1935 cotton growing in the Philippine Islands was attacked by *Sclerotium rolfsii*, locally a new record on this host. Infection usually occurred on the stem, or at just below ground-level, and the bark in the affected part turned reddish-brown, shrank slightly, and decayed. The rot developed round the stem and passed upwards to a distance of a few centimetres, and in severe cases infection might reach the woody part of the stem. The death of the plant at the base was followed by wilting of the leaves, the stem sometimes snapping. Seedlings and young plants were specially susceptible. Inoculations of the uninjured stems of cotton seedlings and cotton seeds gave positive results under damp conditions, some of the former plants recovering, recovery being hastened by exposure to sunlight. Infection was rare when mature plants were inoculated. Cross inoculations showed that the cotton strain also attacked *Musa textilis*, egg-plant, lettuce, groundnut, soy-bean, tomato, and rice, while strains from the five first named infected cotton. In cultures aversion was strongly manifested between the cotton organism and strains of *S. rolfsii* from other hosts, though the cotton and soy-bean strains appeared to be the same. The disease was greatly reduced by soil sterilization. The most practical method of control consists in the prompt removal and burning of all affected parts and the soil in their immediate vicinity. If the attack is severe the plants should be sprayed with a fungicide. Among other diseases of cotton observed was a dry rot of the flowers and bolls constantly associated with a *Fusarium.* A seedling stem rot was associated with *F. moniliforme* (*Gibberella moniliformis*), *F. solani* var. *eumartii*, and a *Rhizoctonia.* Anthracnose (*Glomerella gossypii*) attacked all varieties at the Agricultural College. *Schizophyllum commune* was found on cotton bolls which become hard or mummified, and areolate mildew (*Ramularia* [*Mycosphœrella*] *areola*) was recorded for the first time from the Philippines.

713. TAXONOMY OF THE GENUS *Fusarium* AND A METHOD FOR THE DETERMINATION OF THE SPECIES BELONGING TO IT. By Mme. A. I. Raillo. (In Russian, with English summary.) (*Acta Inst. Bot. Acad. Sci. U.S.S.R.*, Ser. II., **3**, 1936. From *Rev. App. Mycol.*, xvi., **7**, 1937, p. 493.) In this paper the author gives a detailed description of the standardized method suggested by her for the systematic study of the fungi belonging to the genus *Fusarium*, as well as instructions for the preparation of the standard culture media (potato agar and acidified potato agar) which she considers as best adapted to maintain a typical development of the organisms. She further recommends that the measurement of macroconidia be made at regular intervals of 15 days from the inception of the cultures to ensure that none is over 15 days old, since her observations showed

that these organs are most characteristic of the given species on the fifteenth day of growth. In the second part dichotomous keys are given for the determination of the sections and species of the genus, based on the work of Wollenweber, though the recent joint monograph of this author and Reinking was received by the writer too late to be taken into consideration in this paper.

714. SECOND CONTRIBUTION TO THE GEOGRAPHICAL DISTRIBUTION OF COTTON WILT (*Fusarium vasinfectum*) IN BRAZIL. By H. P. Krug. (In Portuguese, with English summary.) (*Circ. Inst. Agron. Campinas*, **5**, 1937. From *Rev. App. Mycol.*, xvi., **6**, 1937, p. 380.) *Fusarium vasinfectum* was first recognized in Brazil on cotton from the Textile Plant Experiment Station, Alagoinha, Parahyba, and reported to a meeting of Brazilian phytopathologists in January, 1936. In December, 1936, the fungus was isolated in pure culture from plants growing near Recife, Pernambuco, and its pathogenicity established by inoculation experiments. It is suspected that the organism is present in most of the cotton-growing regions of North-Eastern Brazil.

715. COTTON WILT IN U.S.A. (*Int. Cott. Bull.*, xv., **59**, 1937, p. 381.) A recent survey of cotton wilt fungi by the Bureau of Plant Industry shows that two distinct types of wilt cause damage to the cotton crop: *Fusarium vasinfectum* and *Verticillium albo-atrum*. *Fusarium* wilt is found in the coastal plains of the east and to a limited extent in the Piedmont and upland sections of the south-east. It is apparently more prevalent in the loose, sandy, rather acid soils of this area. *Verticillium* is prevalent in the blackland section of Texas, in Arizona and in New Mexico, and thrives in tightly packed neutral or alkaline soils. The only known means of combating wilt is planting resistant or highly tolerant cotton varieties.

716. ARKANSAS: *Cotton Wilt Studies.* By V. H. Young and L. M. Humphrey. (*Arkansas Sta. Bull.*, 337, 1936. From *Exp. Sta. Rec.*, 76, **5**, 1937, p. 635.) Progress reports are given on a genetical, physiological, and pathological study of the cotton plant, with special reference to cotton wilt *Fusarium vasinfectum*.

717. ARE VIRUSES ORGANISMS OR AUTOCATALYSTS? By H. H. Dixon. (*Nature*, cxxxix., **3508**, 1937, p. 153. From *Rev. App. Mycol.*, xvi., **6**, 1937, p. 399.) Recent work by Stanley, Bawden, and others is considered to lend striking support to the opinion long maintained by the writer concerning the autocatalytic (as opposed to organic) nature of viruses. This view is based on the absence of a limiting surface between the material of a virus and its host; the velocity of the transmission of its typical symptoms (10 to 30 cm. per hour) in the host tissues; its rapid multiplication; and the infinitesimally small quantities required for inoculation. The autocatalytic theory receives further confirmation from Caldwell's observations on the rapid migration of the viruses from growing tissues, their passage from cell to cell by way of the plasmodesmata, and their inability to penetrate a barrier of dead cells or unperforated cell walls.

GENERAL BOTANY, BREEDING, ETC.

718. AN INTRODUCTION TO THE PRINCIPLES OF PLANT PHYSIOLOGY. By W. Stiles. (Methuen and Co., London, 1936. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 763.) This text is addressed more particularly to university students. In it the purely biochemical details are introduced only in so far as reference to them has appeared essential to an understanding of the physiology of the plant. The subject matter is arranged under the general physiology of the cell, metabolism, the physiology of development, and irritability and movement. The literature references cover over 39 pages, and an index completes the work.

719. METHODS IN PLANT PHYSIOLOGY. By W. E. Loomis and C. A. Shull. (McGraw-Hill Pubg. Co., Ltd., London, 1937. Price 25s. From *Bull. Imp. Inst.*, xxxv., **2**, 1937, p. 278.) This book is designed to meet the needs of students, teachers, and research workers, and the wide field is covered without assuming an advanced scientific knowledge on the part of the reader. The text is arranged in two parts: the first contains descriptions of laboratory experiments (over 180 are described), while the second part deals with more general methods of procedure likely to be of use to research workers. The experiments are set out in twelve chapters dealing with the principal topics of plant physiology. In addition to directions for carrying out the experiments, each chapter includes a brief discussion on the work involved, and a short list of books for further study. Experiments suitable for elementary, intermediate, and advanced work are not separated, but are indicated by the letters (E), (I), and (A) respectively. Pt. II. deals mainly with methods and apparatus used for bio-physical determinations and chemical analyses of plant material, and includes a chapter on the measurement and control of plant environment. The concluding chapter on statistical methods has been contributed by Professor G. W. Snedecor, of Iowa State College, and forms a most useful feature. There follow an appendix of thirty-three tables and the index; the former gives physical and chemical data required in the experiments described.

720. COMPARATIVE ANATOMY OF THE SEEDS OF COTTONS AND OTHER MALVACEOUS PLANTS—I. II. By R. G. Reeves. (*Amer. Jour. Bot.*, 23, **4** and **6**, 1936. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 767.) This is a contribution by the Texas Experiment Station; Part I., dealing with the Malveæ and Ureneæ, and Part II., with various species of Gossypium and related species.

721. SEEDLING ABNORMALITIES IN COTTON. By L. Neelakantan and G. Kontareddy. (*Madras Agr. J.*, 25, 1937, p. 50. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 364.) Four different types of abnormalities affecting the structure, attachment and number of the cotyledons of cotton seedlings are briefly described.

722. "ROUND-LEAF" COTTON. NOTE ON THE APPEARANCE AND BEHAVIOUR OF A PECULIAR NEW STRAIN. By H. B. Brown and J. R. Cotton. (*J. Hered.*, 28, 1937, p. 45. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 412.) A cotton plant with rounded leaves found in 1930 among a block of Upland cotton is described. It bred true to type, but each year bud mutations have appeared on some of the plants. Crosses of the mutant with normal broad-leaf plants and with okra-leaved plants showed an approximation to a di-hybrid ratio, but some broad-leaved plants and other types unexpectedly turned up in the cross with the okra-leaved strain. The chromosomes are apparently normal.

723. BREEDING IN THE CAMPAIGN FOR LINT QUALITY IN COTTON. By A. T. Svetasov. (*Bor'ba za Khlopok* [Cotton Campaign], 6, 1936. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 411.) In Russia the quality of the new Egyptian varieties is high, but the yield and ginning outturn are low. With a view to remedying this they are being crossed with large bolled cottons from Brazil and Peru. Breeding is also being done with Upland cottons to increase their lint length, the variety Wilds serving as the chief starting-point. One of the selections, No. 902-16, has lint 35·3 mm. in length, and exceeds Navrotskii by 9 per cent. in yield of lint.

724. STUDIES ON THE INHERITANCE OF CHINESE COTTON. Y. Chi-Pao and H. Yuen-Ling. (*J. Agr. Res.*, Nat. Cent. Univ., Nanking, 1934, i., **2**, p. 135. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 411.) The following allelomorphs affecting the colour of the centre of the flower (spot) were established: R (red centre), R_y (yellow centre) and r (white centre). R is dominant over R_y and r, but the heterozygote $R_y r$ has a red centre, segregating into 1 yellow : 2 red : 1 white on selfing. In studying the inheritance of leaf shape, Leake's leaf factor was found to be better than the leaf index. A single factor pair *Cf* (deep serration), *cf* (shallow serration) was found to be operating, with incomplete dominance. The presence of glands on the leaf was determined by a single dominant gene *Ne*, the glandless condition (*ne*) being recessive. Red petal margin was conditioned by a single factor *We*, the recessive *we* producing no red margin. The following factors for colour of stem were found: P_y, P_o, p_o and p_o'. P_y produces the purple stem of yellow-centred Chinese cotton, P_o the purple stem of ordinary Chinese cotton, p_o green stem (red colour under green epidermis) and p_o' sun-red. When yellow-centred, purple-stemmed Chinese cotton was crossed with yellow-centred, green-stemmed cotton the F_2 segregated into 12 purple : 3 green : 1 sun-red. Yellow-centred, purple-stemmed Chinese × purple-stemmed Fenghsien cotton gave an F_2 segregation into 15 purple : 1 sun-red. Yellow petal colour was incompletely dominant over white or cream, giving 3 : 1 segregation in F_2 of crosses yellow × white or yellow × cream. The genes for petal colour and colour of flower-centre were independent in inheritance. The latter was also shown to be independent of the factor for leaf shape and the former of the factor for glands.

725. AMOUNT OF CHLOROPHYLL IN CHINESE COTTON. By Y. Chi-Pao. (*J. Agr. Res.*, Nat. Cent. Univ., Nanking, 1934, i., **2**, p. 109. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 412.) Considerable varietal differences in chlorophyll content were observed. In F_1 hybrids the chlorophyll content was less than in either parent. The content was nearly identical in direct and reciprocal hybrids, suggesting that the character is subject in this case to nuclear rather than to plasmatic control. There appeared to be some correlation between the period of ripening and the chlorophyll content.

726. GUATEMALA UNA VARIEDAD DE ALGODON PARA EL PORVENIR. By E. Deger. (*Rev. Agr. Guatemala*, 1936, 14, p. 148. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 412.) A new hybrid between perennial and Upland cottons is described. It is perennial in habit, resistant to the two main pests, *Anthonomus grandis* Boh, and *Gelechia gossypiella*, gives a prolific yield of bolls both in humid tropical regions and in more temperate zones; its abundant lint is of superior quality, silky, very glossy, smooth, long, strong and perfectly white.

727. WHAT IS NEW IN BREEDING EGYPTIAN COTTON? By A. Avtonomov. (*Bor'ba za Khlopok* [Cotton Campaign], 7, 1936. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 410.) Breeding work with Egyptian cotton was started in Russia in 1931, and varieties have now been produced which exceed Maarad in earliness by 10-12 days, *e.g.*, No. 35-1 with lint 36-38 mm. and No. 35-4 with lint 40-42 mm. in length, both having bolls of medium size and yielding 10-15 per cent. more than Maarad. In the attempt to effect still further yield increases the Egyptian cottons are being crossed with the large-bolled perennial Peruvian cottons. The F_5 in 1936 contained some very uniform families in which the weight per boll equalled 5-6 gm. and the lint length 38-43 mm.; the time of ripening was mostly about the same time as Maarad, but in some promising families was 2-3 days earlier.

728. RESULTADOS DE LA SELECCION DEL ALGODON TANGUIS EN EL VALLE DE CAÑETE. By A. Correa y Elias. (*Min. de Fomento*, Asociacion de Hacendado de Cañete, Peru, December, 1936. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 413.) Selection has been practised for the production of strains true to the original Tanguis type, and at the same time resistant to wilt. Attempts to reproduce the Tanguis type by crossing have failed, and the work was carried out on the basis of the material still available, which was thought not to be identical with the original Tanguis, which was heterozygous, and has given rise to a somewhat varied progeny. Detailed observations have been made on a progeny of a single plant selection made in 1926; the lint is 1¼ inches to 1$\frac{5}{16}$ inches, uniform, strong and tough, semi-rough, lint percentage 38·9 and lint index 7·12; the seeds are small, naked and brown; the percentage of brown lint has been reduced in the course of selection from 15-16 to under 5 per cent. The wilt infection is much reduced and the strain has been multiplied and seed is now being distributed.

729. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation, price 2s. 6d., post free.) The tenth number of Series B, Physiology, has recently been published, and contains the following paper reprinted from the *Annals of Botany*:

"The Effects of Light and Oxygen on the Uptake of Sugar by the Foliage Leaf." By E. Phillis and T. G. Mason. The formation of starch by discs of cotton leaf, previously destarched and then immersed in sugar solution, is accelerated independently by oxygen and by light. Both factors would appear to hasten starch formation by increasing the rate of absorption of sugar by the leaf rather than by an effect on the starch-sugar equilibrium. The possible mechanisms by which such increased absorption of sugar could be brought about are briefly discussed; though the data are insufficient to enable a decision to be made concerning the manner in which light and oxygen act, it seems probable that light increases the permeability of the plasma membrane and that oxygen affects the solvent capacity of the cytoplasm.

730. THE TRANSLOCATION OF SOLUTES IN PLANTS: A CRITICAL CONSIDERATION OF EVIDENCE BEARING UPON SOLUTE MOVEMENT. By O. F. Curtis. (McGraw-Hill Pubg. Co., London, 18s. net.) The various chapters deal with the following: The significance of translocation and earlier opinions as to tissues involved; evidence for the upward transport of organic matter through the phloem; evidence for the upward transport of nitrogen and salts through the phloem; evidence indicating downward transport through the xylem; a comparison of criteria and methods used to determine the tissues of transport; the method of movement through the phloem; possible relations between solute distribution and behaviour.

731. LOCALIZATION OF PENTOSANS IN THE RESIN GLANDS OF THE COTTON EMBRYO. By R. G. Reeves and J. O. Beasley. (*J. Agr. Res.*, 54, **9**, 1937, p. 711.) Microchemical tests were made upon resin glands of the cotton embryo with the view of determining whether pentosans are localized in them. Since the phloroglucinol-hydrochloric acid test, which is the best of the known microchemical tests for pentosans, is not specific, and since numerous colour changes were caused by other reagents on various parts of the cotton plant, a number of supplementary tests were made in order to determine the applicability of the phloroglucinol-hydrochloric acid test. In spite of the difficulties encountered in interpreting the reactions for pentosans, the phloroglucinol-hydrochloric acid test used according to standard procedure was found to cause a change in the glands of the embryo that is acceptable as a pentosan reaction. This test was verified with orcinol and with naphthoresorcinol as substitutes for phloroglucinol. No other reagent produced a change in the glands which closely resembled that caused by the standard pentosan reagents. The tests used for pentosans in this investigation cannot be successfully applied to the resin glands of the leaves on account of the presence of pigments which mask and otherwise confuse the results. The glands were the only part of the embryo that gave a strong indication of the presence of pentosans. The evidence obtained from this study strongly indicates that the resin glands are the chief containers of whatever pentosans are present in the cotton embryo.

732. On the Occurrence of "Crinkled Dwarf" in Gossypium hirsutum L. By J. B. Hutchinson and R. L. M. Ghose. (*J. of Genetics*, vol. xxxiv., 3, 1937, p. 437.) The published accounts of the behaviour and genetics of Crinkled Dwarf in *G. barbadense* are summarized. The origin and genetic behaviour of a Crinkled in *G. hirsutum* are reported. It is shown that it arose as a mutant at the same locus as Crinkled Dwarf in *G. barbadense*, and behaves as a complete recessive in crosses with normal strains of Upland. In an F_2 of a cross between Indore Crinkled and the Egyptian "Wrinkled Leaf" (identical with Sea Island Crinkled Dwarf) all grades between fully normal and extreme Crinkled were obtained, an exactly parallel behaviour to that found by Harland in crosses between Sea Island Crinkled and Crinkled transferred to the Upland genotype. The bearing of the data on Fisher's theory of the origin of dominance by selection among heterozygotes is discussed, and it is shown that the occurrence of Crinkled by mutation in *G. hirsutum* disposes of one of Harland's main objections to the selection theory. His other objection is that the intermediate heterozygote is not actually at a disadvantage compared with the normal. His data are re-examined, and it is shown that it was to be expected that the vigour of the heterozygote would be maintained by unconscious selection in the back-crossing series. The available evidence on the history of the mutant and its dominance modifiers is reviewed, and it is concluded that, while the mutation has been recurrent since before the separation of the species, dominance of normal is probably a comparatively recent development. From this it is predicted that dominance should be broken down if Crinkled is transferred from the cultivated annual forms of *G. barbadense* to perennial types of the same species recently brought on to the research farm from the indigenous bush, or from the more or less spontaneous shrubs to be found in peasant gardens. Further, it is shown that it is reasonable to expect that the modification of Crinkled will have gone farther in *G. hirsutum*, annual types of which have long been cultivated, than in *G. barbadense*, in which the annual habit is of late origin, and to which field cultivation, with its accompanying low seed rate and seedling thinning, has only recently been applied. It is shown that the behaviour of Indore Crinkled provides very good evidence of the correctness of this expectation. Not only is normal completely dominant, but the Crinkled homozygote has also been considerably improved (as predicted also by Fisher, 1928). Indeed it is practically normal for the greater part of its life cycle under greenhouse conditions at Indore, and only slightly malformed in the field in parts of Rajputana. It is concluded that the whole of the evidence now available is in close agreement with expectation on Fisher's theory of the origin of dominance by the selective improvement of the heterozygote.

733. The Classification of the Cottons of Asia and Africa. By J. B. Hutchinson and R. L. M. Ghose. (*Ind. J. Agr. Sci.*, vii., 2, 1937, p. 233.) *Summary*: The present state of knowledge concerning the classification of *Gossypium* species is summarized with particular reference to the literature on Asiatic cottons. A classification of the indigenous and naturalized cottons of India and Africa is developed on the basis of modern genetic and taxonomic knowledge. Cultivated Asiatic cottons are classified as follows:

G. arboreum L. var. (*a*) *typicum.*
,, ,, ,, (*b*) *neglectum.*
,, ,, ,, (*c*) *cernuum.*
G. herbaceum L. var. (*a*) *typicum.*
,, ,, ,, (*b*) *frutescens.*
,, ,, ,, (*c*) *africanum.*

G. arboreum var. *typicum* and *G. arboreum* var. *neglectum* are divided on geographical grounds, and on account of their recent evolutionary history, into four forms:

I. forma *bengalensis*; II. forma *burmanica*; III. forma *indica*; IV. forma *soudanesis*.

Cultivated New World cottons are classified according to Harland's scheme into: *G. hirsutum* L.; *G. religiosum* L.; *G. barbadense* L.

G. Stocksii Mast., the wild cotton of Sind and Arabia, and *G. anomalum* Wawra and Peyr., the wild cotton of Somaliland and the Sudan, are described, and the parallelism between them and *G. herbaceum* L. *and G. arboreum* L. is discussed. *G. Bakeri* Watt, a little-known wild species from Sind, is mentioned. Reference is made to *Cienfugosia triphylla* Engler, which is transferred by Chevalier (1933) and Skovsted (1935) to *Gossypium* as *G. triphyllum.*

The distribution of the Asiatic species and recent evolutionary trends in them are discussed.

The present status of the New World species in India and Africa is summarized.

734. SOME REMARKS ON THE WORK OF THE ODESSA INSTITUTE OF PLANT BREEDING AND GENETICS. (In Russian.) (*Soc. Reconstr. of Agr.*, 1936, No. XI., pp. 121-30 and 131-38. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 370.) While acknowledging the practical value of vernalization, P. N. Konstantinov and others point out its natural limitations and criticize some of Lysenko's methods (pp. 121-30). In the following paper (pp. 131-38) Lysenko replies to the criticism, which he ascribes to a desire to bring the Odessa school into disrepute.

735. VERNALIZATION. By F. G. Gregory and O. N. Purvis. (*Nature*, **138**, No. 3484, 1936, p. 249. From *Exp. Sta. Rec.*, 76, **5**, 1937, p. 607.) From experiments with excised cereal embryos it would appear that the " cause " of vernalization by low temperature lies entirely in the embryo.

736. THE PLACE OF IAROVIZATION IN PLANT BREEDING. By A. J. Bruman. (*J. Hered.*, 28, 1937, p. 31. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 369.) The possible significance of vernalization in plant breeding is discussed. It is pointed out that though the subject is as yet incompletely worked out, it does open up a new field for research.

737. GROWTH HORMONES IN PLANTS. By P. Boysen Jensen. (McGraw-Hill Pubg. Co., Ltd., Aldwych House, London, W.C. 2, 1936. 21s. net.) The first comprehensive review of the literature dealing with the rôle of growth hormones in normal growth and tropisms of plants, by the discoverer of growth hormones in plants. The book includes such topics as techniques of investigation, chemistry, formation, transport (electrical, etc.), the significance of hormones for normal growth, and other phenomena.

738. TWENTY-FIVE YEARS OF CYTOLOGY, 1910-1935. By C. E. Allen. (*Mem. Brooklyn Bot. Gdn.*, 4, 1936, p. 11. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 376.) The developments in cytology are very briefly reviewed. The advances made in the knowledge of cytoplasmic structure, the problem of the nucleolus, the morphology of the chromosomes, sex chromosomes, the chromosomes of the salivary glands of flies, chromonemata, chiasmata and fragmentation are mentioned.

739. IMPROVEMENTS IN PLANT CYTOLOGICAL TECHNIQUE. By L. LaCour. (*Bot. Rev.*, 3, 1937, p. 241. From *Pl. Bre. Absts.*, vii., 4, 1937, p. 377.) A valuable survey, based on the author's wide experience, of methods now in use, including some very recent improvements. An extensive bibliography is provided.

740. INVESTIGATIONS ON THE FORMATION OF THE CELL WALL. By K. Hess *et al.* (*Planta, Arch. Wiss. Bot.*, 25, **3**, 1936, p. 419. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 764.) A study of the cytology and chemistry of cell wall development in cotton root hairs, oat coleoptiles, and young beech shoots is reported, using X-ray and polarization methods.

741. TWENTY-FIVE YEARS OF GENETICS, 1910-1935. By A. F. Blakeslee· (*Mem. Brooklyn Bot. Gdn.*, 1936, **4**, p. 29. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 369.) Taking 1900 as the real starting point of the science of genetics, the author considers the first 10 years to have been concerned mainly with Mendelian ratios. During the last 25 years the emphasis has been on the genes and chromosomes. During this period Drosophila has been the material *par excellence* for genetical work, and three methods of investigation are mentioned as of outstanding importance: the aceto-carmine method for cytological technique, the artificial induction of mutation, and the technique based on the discovery that the structures in the salivary glands of fly larvæ are chromosomes with markings corresponding to the gene loci. The species problem has made considerable advances towards solution, and it is suggested that genes and chromosomes will be the basis for future attack, with the possibility of a later conscious control of evolution.

742. A GLOSSARY OF GENETIC TERMS. (*J. Hered.*, 28, 1937, p. 71. From *Pl. Bre. Absts.*, vii., **4**, 1937, p. 372.) This glossary is published in an admittedly imperfect form, with a request for emendations and corrections. It is intended ultimately to publish it in its final form as a booklet.

743. PRACTICAL PHOTOMICROGRAPHY. By J. E. Barnard and F. V. Welch. (Longmans, Green and Co., New York. Edward Arnold and Co., London, 1936. From *Exp. Sta. Rec.*, 76, **6**, 1937, p. 764.) A thorough discussion of the optical principles involved, types of instruments and illuminants available, and technical methods employed in photomicrography, is brought up to date in this edition.

FIBRES, YARN, SPINNING, WEAVING, ETC.

744. RAW COTTON: PRICE. By D. de Prat. (*L'Ind. Text.*, **54**, 1937, p. 109. From *J. Text. Inst.*, xxviii., **5**, 1937, A351.) A discussion of the influence of supply and demand on the price of American cotton. The author shows the difficulties of forecasting the price of cotton, and believes that the amount of the crop and the demand are the only really significant factors.

745. PROCESSING LOSSES IN THE SPINNING MILL. By A. Bosshardt. (*Rev. Fil. et Tiss.*, 22, **103**, 1937. From *Text. Wkly.*, xx., **490**, 1937, p. 105.) Discusses the weight and value of the losses sustained during the processing of raw cotton. The author's thesis is that cotton is purchased according to type (the method is briefly described) and therefore the determination of the type should be based on detailed study of the loss, both in weight and value, during processing. As an example, details are given of the amounts of waste produced in the opening, cleaning and carding processes with an initial 200 kilogrammes (440 lb.) of cotton. The weight of cotton required to produce 100 kg. of sliver is calculated, its price is determined and from this is subtracted the value of the waste produced. The difference between the figure thus obtained and the price of 100 kg. of cotton gives the loss in cash of the cotton during the production of 100 kg. of sliver.

746. FIBRE CROSS-SECTIONS: PREPARATION. By W. v. Bergen. (*Textilber.*, **18**, 1937, p. 1. From *J. Text. Inst.*, xxviii., **5**, 1937, A276.) Methods for the rapid preparation of fibre cross-sections are reviewed, and their various applications are indicated. Photomicrographs of cotton, silk, wool, rayon and hair sections are given and discussed.

747. Cotton Hair Primary Substance: X-Ray Diagram and Constitution. By J. Gundermann, W. Wergin and K. Hess. (*Ber. Dtsch. Chem. Ges.*, **70**, 1937, p. 517. From *Summ. of Curr. Lit.*, xvii., **9**, 1937, p. 266.) In recent lectures Hess and his co-workers have announced that the growing cotton hair (from hot-house plants) does not show the main features of the X-ray diagram of cellulose until about the thirty-fifth day from the fall of the flower. Until then the diagram is characterized by two strong interferences of $d = 4 \cdot 14$ and 3·73 Å, ascribed to the "primary substance" of the cell wall. It is now shown that these frequencies are those of long-chain hydrocarbon systems and more particularly of the waxes; they are given, for example, by carnauba wax. The period of the interferences is about 83 Å, which corresponds with a total chain length of about 64 C atoms. That is to say, the "primary substance" probably comprises compounds of alcohols and acids of the series C_{30}, C_{32} and C_{34}. The benzene extract of young cotton (15 days) is a wax with the same diagram, and m.p. 77-79° C. The wax from ripe cotton is a more complex mixture; it has m.p. 68-78° C. and is resolved by methyl alcohol into an insoluble fraction with the same diagram as the wax from the young hair, and a soluble part with a period of 55 Å. The C_{30}-C_{34} waxes of young cotton appear to be mixed with waxes down to C_{24} in ripe cotton. Evidence that the wax belongs to the cell wall rather than the cell content is provided by grinding the young hairs with sand under water so as to disintegrate the walls and wash away the cell content; on pressing the residue to a compact, dry mass it could be stained with Sudan III. Although the young hair does not exhibit the main equatorial 101, $10\bar{1}$ and 002 interferences of cellulose, the diagram includes a very sharp interference that persists after solvent extraction of the hair and corresponds with the fourth order interference of the base of the cellulose crystallite. This 040 interference is best seen in hairs up to nine days old, but is also shown, in addition to wax interferences, by young coleoptiles of barley, many other seed hairs (poplar, dandelion, etc.), and the glumes of barley and rye. The appearance of the equatorial interferences, therefore, is not an indication of the first development of cellulose, but only of the onset of the secondary thickening. The rôle of wax in the growth of the hair is discussed, and the conclusion is drawn that, in the early stages at least, the framework of cellulose and the impregnating wax are formed from the protoplasm simultaneously. It is not suggested that the wax is utilized in the further development, but that the thickening of the cellulose proceeds to such an extent that the small amount of wax in the ripe hair escapes detection by the X-ray method. Work of Fargher and Probert, and Piper, Chibnall, and others on the waxes is cited.

748. A Spinning Procedure for Cotton Samples. By H. A. Hancock. (*J. Text. Inst.*, xxviii., **5**, 1937, T161.) The technique employed in the Spinning Test Mill at Giza, Egypt, is described. The standard error of a spinning test under conditions specified is shown to be about 1 per cent. In comparing the spinning values of old or new varieties, the strength level to which the yarns are spun is found to be of little consequence. Providing the cottons are given identical treatment, they rank in much the same order whether spun from combed or from carded preparation, in fine or in coarse counts, in warp twist or in doubling weft, over the range of Egyptian cottons. A spinning in a medium counts carded yarn gives sufficiently accurate information for most purposes. The cash value of a cotton sample may be estimated from the result of its spinning-test.

749. Textile Fibres: Action of Light on. By J. Dumas. (*Rev. Gen. Mat. Col.*, **41**, 1937, p. 149. From *Summ. of Curr. Lit.*, xvii., **12**, 1937, p. 345.) A review of investigations of the action of light on wool, silk and cotton.

750. A Portable Ultra-violet Fluorescence Lamp for the Examination of Textile and other Materials. By D. A. Derrett-Smith. (*J. Text. Inst.*, xxviii., **5**, 1937, T145.) A description of the apparatus. It enables the material under examination to be "scanned" with ultra-violet light, the lamp being brought to the material instead of the material to the lamp, as is the case with the fixed types of fluorescence apparatus.

751. Cotton Yarn: Lea Strength and Count Relationship. By M. E. Campbell. (*U.S. Dpt. Agr. Circ. No.* 413, 1936. From *J. Text. Inst.*, xxviii., **5**, 1937, A277.) Current formulæ for correcting lea strength to a nominal count are critically reviewed, and shown to be in need of a correcting term. Such a term is obtained from the results of spinning tests on 425 different cottons ranging in staple by eight groups from $\frac{13}{16}$ to $1\frac{9}{32}$ inches, in which more than 70,000 lea tests were made under standard conditions. The count-strength products were plotted for 22's, 28's, 36's and 44's yarn in each of the eight staple-length groups, fitted to straight-line curves by the method of least squares (with proper weighting of the data), and the slopes of the curves were calculated. It was found that 1 unit of count corresponded with 25·1-15·9 units of count-strength product, going from the shortest group to the longest. An average figure of 21·7 is introduced into the proposed conversion formula, $S_2 = \frac{C_1S_1 - 21{\cdot}7\,(C_2C_1)}{C_2}$ where S_1 is the observed lea strength, S_2 the corrected strength, and C_1 and C_2 are the observed and specified counts. Mill work is simplified by drawing up a table of the calculated values for a nominal count; a table for 22's is shown for the range of observed counts 20-24 and lea strengths 80-99 lb. Appropriate nomograms are also provided. Examples of the application of the formula are described.

TRADE, PRICES, NEW USES.

752. Lancashire and the Future: The Present Position and Prospects of the Cotton Industry. (Joint Comm. of Cotton Trade Organizations, Manchester, June, 1937.) In this survey it is shown how the exports of cotton goods have shrunk to a third of their pre-war volume, but are still by far the largest single item in Britain's overseas trade. The history of the decline is discussed, and the Committee indicates that a solution of the difficulties of the industry can best be found in the preservation of its overseas markets by the aid, where necessary, of the British Government, and by facilities for internal réorganization, with a view to strengthening competitive ability in export trade. Given these facilities it is believed that Lancashire can once again hold out the prospect of stable and attractive employment, and of a reasonable return on invested capital.

753. Taking Stock: Lancashire's Present and Future Position in Textiles. By F. Nasmith. (*Text. Wkly.*, xix., **468/9**, 1937, pp. 249 and 279.) A report of a lecture discussing the repercussions of 1914-18, Japanese competition, tariffs, hours of work, and the values of basic commodities.

ADDENDA.

754. A Notebook of Tropical Agriculture. Compiled by R. Cecil Wood. (Pubd. by the Imperial College of Tropical Agriculture, Trinidad. Price 5s. post free.) The first edition of this most informative little book was published in 1933, and met with such good demand that all copies were exhausted by 1936. A second edition, of the same convenient size for the pocket, has now appeared, in which the author has made a few alterations which will increase the usefulness of the book. [*Cf.* Abstr. **416**, p. 235, Vol. X. of this Review.]

755. INDIAN COTTON CHART, 1936-37. We have received from Messrs. Chunilal, Mehta and Co., Bombay, a copy of their annual cotton chart, which is published for the thirteenth year in succession. The chart is issued at the termination of the Broach contract for April-May delivery. The usual April-May Broach quotations in Bombay and corresponding contract quotations for American cotton in Liverpool and New York are given and the spot quotations for silver in London are again included. Three insets in the chart relate to (*a*) the acreage, crop, and yield per acre figures of Indian cotton for the past ten years; (*b*) the acreage, crop, and yield per acre for Indian and American cottons for the 1936-37 season; (*c*) the bank rate in India, which continued to remain at 3 per cent. during the entire period.

ERRATA.

Abstr. **404**, p. 241 of July issue; *for* Spinning *read* Spacing.

Abstr. **441**, p. 248, line 4, *for* Belgian Congo *read* Morocco.

PERSONAL NOTES

APPOINTMENTS

Mr. B. L. Mitchell has been appointed by the Corporation for work on insect pest control in Nyasaland. Before proceeding to Nyasaland Mr. Mitchell will spend eight months at Barberton in order to study the technique of the work which has been evolved there.

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing the following officers are on leave in this country from cotton-growing countries:

Ceylon	Mr. M. Crawford.
Gambia	Mr. J. Pirie.
Gold Coast	Mr. W. H. Beckett.
„ „	Mr. C. W. Lynn.
Kenya Colony	Mr. D. C. Edwards.
„ „	Captain J. McDonald.

Kenya Colony	Mr. J. T. Moon.
„ „	Mr. W. O. Sunman.
„ „	Mr. H. B. Waters.
Nigeria	Captain J. R. Mackie.
„	Mr. J. K. Mayo.
„	Mr. R. F. A. L. Reed.
„	Mr. H. Roebuck.
„	Mr. D. B. Sabiston.
„	Mr. R. B. Shorter.
„	Mr. F. W. Toovey.
„	Mr. J. W. Wallace.
Nyasaland	Mr. R. E. Jackson.
„	Dr. W. Small.
Tanganyika Territory	Mr. D. F. T. Brown.
„ „	Mr. T. C. Cairns.
„ „	Mr. J. G. M. King.
„ „	Mr. T. W. Kirkpatrick.
„ „	Mr. C. J. McGregor.
„ „	Mr. N. V. Rounce.
„ „	Mr. A. H. Savile.
„ „	Mr. A. S. Stenhouse.
„ „	Mr. R. J. M. Swynnerton.
„ „	Mr. G. B. Wallace.
Uganda	Mr. H. Hargreaves.
„	Mr. H. G. Smith.
„	Mr. E. G. Staples.
„	Mr. T. H. C. Taylor.
„	Mr. A. S. Thomas.
„	Dr. J. D. Tothill.
West Indies: *Barbados*	Mr. R. W. R. Miller.
„ „ *Jamaica*	Mr. A. C. Barnes.

The following officers of the Corporation's staff abroad are on leave in this country:

Nigeria	Mr. G. Browne.
Nyasaland	Mr. W. L. Miller.
Southern Rhodesia	Mr. A. N. Prentice.
West Indies: *Trinidad*	Mr. R. A. Silow.

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher

THE EMPIRE COTTON GROWING REVIEW

INDEX OF AUTHORS TO VOL. XIV.

		PAGE
Abaza, Fouad Bey	"Bahtim Abiad" - - - - - -	151
	"A White Cotton for Egypt" - - - - -	151
Adams, J. J. ..	"A Review of the Co-operative Movement in South Africa" - - - - - - - -	238
Afzal, M.	"A Note on the Hairiness of Cotton" - - -	86
Ahmad, N. ..	"The Effect of Raising the Middle Roller and Some Other Factors on the Yarn Strength of Sindhi Cotton" -	162
	"Spinning Test Reports on Indian Cotton, 1935-36"	54, 143
	"Spinning Test Reports on Indian Cottons, 1936-37"	233, 318
	"Spinning Tests on Mixtures of Staple Fibres and Indian Cottons" - - - - - -	233
	"Technological Reports on Indian Cottons, 1935-36" -	54
	"Technological Reports on Indian Cottons, 1936-37" -	233
	"Technological Reports on Standard Indian Cottons, 1936" - - - - - - - -	54
	"Technological Reports on Trade Varieties of Indian Cottons, 1936" - - - - - -	234
Ahmad, N., and Nanjundayya, C.	"A New Method and Apparatus for Determining the Average Length and Fineness of Cotton Hairs" -	179
Ainscough, Sir Thos.	"Rpt. on Economic and Commercial Conditions in India, 1935-36" - - - - - - - -	143
Allan, F. E. ..	"Some Principles of Statistics and their Application to Agricultural Experiments" - - - - -	254
Allan, W. ..	"The Influence of Climate on *Dysdercus* spp. through their Wild Host Plants" - - - - -	76
	"The Relation between Climate and Pests of Cotton in Northern Rhodesia" - - - - - - -	76
Allen, C. E. ..	"Twenty-five Years of Cytology, 1910-1935" - -	354
Ambegaokar, K. N., and Wad, Y. D.	"Studies in Disease Resistance. I. Cotton Wilt and Environment" - - - - - - -	80
Anderson, P. J., *et al.*	"Report of Tobacco Substation at Windsor, Connecticut, 1935" - - - - - - - - -	245
Andrews, F. W. ..	"The Effect of Leaf Curl Disease on the Yield of the Cotton Plant" (Erratum) - - - - -	91
	"Investigations of Blackarm Disease of Cotton under Field Conditions. I. The Relation of the Incidence and Spread of Blackarm Disease of Cotton to Cultural Conditions and Rainfall in the Anglo-Egyptian Sudan" - - - - - -	78
	"Investigations on Blackarm Disease of Cotton under Field Conditions. II. The Effect of Flooding Infective Cotton Débris" - - - - -	345
Anstead, R. D. ..	"Cultural Methods of Controlling Plant Diseases" -	170
Arndt, C. H. ..	"Phytopathological Studies: South Carolina" - -	79
Arutjunova, L. G.	"An Investigation of Chromosome Morphology in the Genus *Gossypium*" - - - - - -	176
Astbury, W. T. ..	"Textile Fibres: Structure and Properties" - -	180
Avtonomov, A.	"What is New in Breeding Egyptian Cotton?" - -	351
Aylen, D., and Hamilton Roberts, R.	"Soil Conservation" - - - - - -	251
Ayres, Q. C. ..	"Soil Erosion and its Control" - - - - -	332

Ayyangar, G. S. ..	Letter *re* " The Early Development of the Cotton Fibre " (Sheffield) - - - - - - -	141
Ayyar, T. V. R., and **Margabandhu V.**	" On Some Parasites found in Association with the Stem Weevil Pest of Cotton in South India (*Pempheres affinis*, F.) and their Rôle in its Biological Control "	262
Babayan, A. A., *et al.*	" Contribution to the Knowledge of Cotton Gummosis and to its Control in Transcaucasia " - - -	345
Bal, D. V.	" Some Methods of Soil Management " - - -	250
Ball, R. S. ..	" Mixed Farming in East Africa. I. Grassland and Arable Dairying in Certain Parts of Kenya " - -	162
Ballinger, R. A.	" Results of the Regulation of Cotton Gins as Public Utilities in Oklahoma " - - - - -	62
Ballinger, R. A., and **Soxman, R. C.**	" Some Economic Problems of Cotton Gins in Oklahoma "	328
Balls, W. L. ..	" Source of Egypt's Wealth: The Romance of Cotton " -	151
	" Water-weight Changes in Export and Country Bales "	61
Balls, W. L., and **Hancock, H. A.**	" The Effect of Jute on the Spinning Value of Cotton " -	179
Balsson, B. F. ..	" Seed Cotton: Drying and Air Resistance " - -	72
Barber, C. R. ..	" The Alexandria Futures Market " - - -	325
Barber, G. W. ..	" The Cannibalistic Habits of the Corn Earworm (*Heliothis obsoleta*) " - - - - - - -	73
	" Efficiency of *Trichogramma minutum* Riley in Relation to Population Density of its Host " - - -	168
	" Method of Rearing Corn Earworm Larvæ (*Heliothis obsoleta*) " - - - - - - -	167
Barker, A. F. and **K. C.**	" The Textile Industries of China, their Present Position and Future Possibilities " - - - - -	247
Barnard, J. E., and **Welch, F. V.**	" Practical Photomicrography " - - - -	355
Barnwell, M. G.	" Sea Island Cotton Cultivation, Florida " - -	245
Barre, H. W. ..	" Control of Root Rot " - - - - - -	171
	" Cotton Investigations in the U.S.A., 1936 " - -	154
	" Improved Method of Ginning Long-staple Cotton " -	162
	" Single Variety Cotton Communities in U.S.A." - -	154
Barthel, C. ..	" The Mobilization of Plant Nutrients in the Soil " -	69
Bebbington, A. G. and **Allen, W.**	" The Pest and the Plant " - - - - -	31
Beckley, V. A. ..	" Composts and Composting " - - - - -	334
Bedford, H. W. ..	" Sudan: Cotton Pests, 1934-35 " - - - -	166
Bekker, E. ..	" The Mouth-Parts of *Tetranychus telarius* and their Function with regard to the Question of the Chemical Control of the Mite " - - - - -	77
Beller, S., and **Bhenchitr, P.**	" A Preliminary List of Insect Pests and their Host Plants in Siam " - - - - - -	165
Bennett, C. A. ..	" Progress in Ginning Tests and Gin Testing Instruments "	70
Bennett, C. A., and **Gerdes, F. L.**	" Effects of Gin-Saw Speeds and Seed-Roll Density on Quality of Cotton Lint and Operation of Gin Stands "	70
	" Saw Gins: Care and Maintenance " - - - -	336
Benson, B. ..	" Cotton Growing in the Sudan " - - - -	148
Benton, M. C. ..	" Financing American Cotton Production and Marketing in the United States " - - - - -	63
Birkeland, J. M.	" On the Classification of Plant Viruses " - -	265
Bishara, I. ..	" Some Pink Bollworm Studies in Egypt " - -	259
Bissell, T. L. ..	" Insects Infesting Cotton Seed " - - - -	165
Black, A. G. ..	" Progress in Improving the Quality of American Cotton "	62
Blakeslee, A. F.	" Twenty-five Years of Genetics, 1910-1935 " - -	355
Blalock, H. W. ..	" Plantation Operations of Landlords and Tenants in Arkansas " - - - - - - - -	327
Bogolubova, V. A., and **Granitova, O. N.**	" Physiology of Cotton Plant attacked by Red Spider "	337
Bogush, P. P. ..	" *Laphygma exigua* Hb. and its Control under the Conditions of Central Asia " - - - - -	337
	" Some Results of a Study of Insects by means of Light Traps, in Central Asia " - - - - -	258

		PAGE
Bordakov, L. P.	"Züchtung der Baumwolle"	81
Bordakov, L. P., and Ivanova, M. M.	"The Importance of the Local Cottons of Afghanistan for Practical Breeding Work in the U.S.S.R."	85
Bosshardt, A.	"Processing Losses in the Spinning Mill"	355
Bouet, G.	"Recherches et Travaux de la Mission Française en A.O.F. État Actuel du Problème des Acridiens Migrateurs en Afrique"	74
Boumphrey, A. N.	"The Tendering of Egyptian Cotton in Liverpool"	151
Boussenot, G.	"Le Coton est en A.E.F. une Source de Richesse"	157
Bouvier, G.	"Une Epidémie chez les Sauterelles Migratrices. Isolement d'un Bacille Pathogène. Essais de Transmission de la Maladie"	261
Bouyoucos, G. J.	"A Rapid Indirect Method for Determining the Wilting Coefficient of Soils"	265
Boysen Jensen, P.	"Growth Hormones in Plants"	354
Boza, T., and Paez, J.	"El Secado Mecanico del Algodon"	256
Braun, G.	"German Cotton Yarn Trade"	248
Bredo, H. J.	"Note sur l'Hibernation du Ver Rose au Congo Belge (*Pectinophora gossypiella*, Saund.)"	259
	"Sommaire des Observations faites au Congo Belge et Projet des Futures Recherches sur les Acridiens Migrateurs"	261
Brierley, W. B.	"Botany's Importance in the Economic Sphere"	266
	"Science of the Year 1936: The Biological Sciences"	266
Brink, R. A.	"A Portable Chamber for Treating Plants with Heat"	255
Brixhe, A.	"Le Dysdercus, Ravageur du Cotonnier"	262
Brown, C. H.	"Giza Varieties"	151, 152
Brown, H. B.	"Registration of Improved Cotton Varieties.—I."	266
Brown, H. B., and Cotton, J. R.	"'Round-leaf' Cotton. Note on the Appearance and Behaviour of a Peculiar New Strain"	350
Bruman, A. J.	"The Place of Iarovization in Plant Breeding"	354
Butler, E. J.	"The Nature of Immunity from Disease in Plants"	170
Byers, H. G.	"Selenium Occurrence in Certain Soils in the United States, with a Discussion of Related Topics"	333
Cameron, G. S.	"Some Aspects of the Promotion of Cotton Growing in Southern Rhodesia"	24
Campbell, M. E.	"Cotton Yarn: Lea Strength and Count Relationship"	357
Cardoso, J. G. A.	"Ainda Sobre os Inimigos do Gafanhoto Vermelho"	75
Carle, G., and Gatefosse, J.	"Un Parasite de Ver Rose en arrête l'Offensive au Maroc"	157
Carruth, L. A.	"Experiments for the Control of Larvæ of *Heliothis obsoleta* Fabr. on Western Long Island during 1935"	73
Carruth, L. A., and Kerr, T. W.	"Reaction of Corn Earworm Moth and Other Insects to Light Traps"	341
Celino, M. S.	"Diseases of Cotton in the Philippines; I. Sclerotium Stem Rot with Notes on Other Diseases"	348
Chadwick, Sir David	"The Imperial Agricultural Bureaux"	93
Chadwick, F.	"Cotton Processing"	89
Chakraborty, J.M.	"The Applicability of Alkaline Permanganate for Oxidation of Organic Matter in Soils for Mechanical Analysis"	331
Charles-Pierre, E.	"Le Coton du Niger"	157
Cheatham, R. J., and Whitaker, R.	"The Use of Cotton Fabric in Road Making in America"	89
Chi-Pao, Y.	"Amount of Chlorophyll in Chinese Cotton"	351
Chi-Pao, Y., and Yuen-Ling, H.	"Studies on the Inheritance of Chinese Cotton"	350
Chinese Cotton Statistics Assocn., Shanghai	"Cotton Industry, China, 1936"	247
Chou, S.	"The Prevalence of the Cotton Geometrid in Haimen, Kiangsu"	341

		PAGE
Christidis, B. G.	"Cotton Seed Delinting with Sulphuric Acid: Effects on Germination"	254
Chunilal, Mehta and Co.	"Indian Cotton Chart, 1936-37"	358
	"Indian Cotton: Review of the 1935-36 Season"	143
Clos, E. C., *et al.*	"Clave Ilustrada de las Especies Cultivadas del Genero Gossypium"	267
Coaton, W. G. H.	"The Harvester Termite"	342
Coile, T. S. ..	"Soil Samplers"	250
Collison, R. C., and Conn, H. J.	"Farm Manure: Its Value and Conservation"	334
Comité Cotonnier Congolais	"Guide pour l'Enseignement Pratique de la Culture du Coton"	329
Comtelburo, Ltd.	"Annual Cotton Handbook, 1936"	90
Cook, M. T. ..	"First Supplement to the Host Index of Virus Diseases of Plants"	265
Corbett, G. H. ..	"On New Aleuriodidæ (Hem)"	262
Cornish, E. A. ..	"Non-replicated Factorial Experiments"	160
Correa y Elias, A.	"Resultados de la Seleccion del Algodon Tanguis en al Valle de Cañete"	351
Cox, A. B. ..	"The Present Position of American Cotton"	153
Crowther, E. M.	"Soils and Fertilizers"	250
Crowther, F. ..	"Experiments in Egypt on the Interaction of Factors in Crop Growth. III. The Effects of Variety, Spacing, Nitrogen and Water Supply on the Development of the Cotton Plant, and the Rate of its Absorption of Nitrogenous Fertilizers"	152
Crowther, F., *et al.*	"Experiments in Egypt on the Interaction of Factors in Crop Growth. IV. Nitrogenous and Phosphatic Manuring of Cotton and their Relation to Variety and Spacing"	153
	"Experiments in Egypt on the Interaction of Factors in Crop Growth. VI. Further Experiments on the Nitrogenous and Phosphatic Manuring of Cotton"	325
Curtis, O. F. ..	"The Translocation of Solutes in Plants: A Critical Consideration of Evidence bearing upon Solute Movement"	352
Cutler, D. W., and Crump, L. M.	"Problems in Soil Microbiology"	331
da Costa Lima, A.	"A New Eumolpid Pest of Cotton"	342
Daniel, H. A. ..	"A Report on the Production of Cotton in the Panhandle of Oklahoma"	328
Darlington, C. D.	"Recent Advances in Cytology"	268
Dastur, R. H. ..	"A Preliminary Note on Cotton Failure in the Punjab and Some Abnormalities in the Plant"	86
Day, E. L. ..	"Government Control of Cotton Production in the United States"	153
de Bauw, A. C. ..	"Cotton Growing in the Belgian Congo"	277
Deger, E... ..	"Guatemala una Variedad de Algodon Para el Porvenir"	351
de Prat, D. ..	"Les facteurs économiques du cours des cotons bruts"	330
	"Raw Cottons: Evaluation"	58
	"Raw Cotton: Price"	355
de Rossi, G. ..	"Chemical Nitrification in Soil"	332
Derrett-Smith, D. A.	"A Portable Ultra-Violet Fluorescence Lamp for the Examination of Textile and other Materials"	356
de Saeger, H. ..	"*L'Apanteles sagax* Wilkn. Parasite de la Pyrale du Cotonnier"	343
	"L'Importance de la Réaction du Sol en Culture Cotonnière et l'Utilité de l'Emploi des Cendres"	332
Deshpande, B. P., and Nadkarny, N. T.	"The Spotted Bollworms of Cotton in South Gujarat"	168
de Sigmund, A. A. J.	"The Principles of the Chemical Characterization of the Soil"	67
Dhar, N. R. ..	"Molasses, Nitrogen Fixation and Land Reclamation"	252

		PAGE
Dharmarajulu, K.	"The Nature of Resistance in Cotton Plants to Stem Weevil"	76
Ditman, L. P.	"Observations on Poison Baits for Corn Earworm Control"	341
Ditman, L. P., and Cory, E. N.	"The Corn Earworm"	341
Dixon, H. H.	"Are Viruses Organisms or Autocatalysts ?"	349
Djelaloff, R.	"Results of Experiments on Gummosis of Cotton in the Sabir-Abad Region of Azerbaijan"	346
Dodd, J. S.	"Cotton, 1936"	272
Doerr, R.	"Allgemeine Merkmale der Virusarten"	266
Dounin, M. S., and Poner, V. M.	"Ozoniosis: Texas Root Rot and its Analogues"	172
Dow, D. M.	"Mechanical Pickers"	163
Doyne, H. C.	"Green Manuring in Southern Nigeria"	333
du Bujanda, E. M.	"La culture du coton en Espagne"	157
Ducker, H. C.	"Relation between Climate and Pests and Diseases of Cotton"	76
Dumas, J.	"Textile Fibres: Action of Light on"	356
Dunlap, A. A.	"Seedling Culture in Sand to Prevent Damping-off"	171
Dunnam, E. W.	"Pilosity of the Cotton Plant in Relation to Adherence of Dusted Calcium Arsenate"	173
Eguti, M.	"The Lethal Point of *Gelechia gossypiella* Saund., at High Temperatures"	166
	"Phototropism of *Gelechia gossypiella* (Saund.) for Purple-coloured and Uncoloured Light Traps"	167
	"Population Density, Habits and Rate of Growth of *Gelechia gossypiella* (Saund.) during the Cotton Cultivating Period"	339
	"On Simple Methods of Fumigating *Gelechia gossypiella* (Saund.)"	167
Ellenhorn, J.	"Differential Chromosome Staining at Meiosis in *G. Peruvianum*"	88
Elsas, M. J., and Ellinger, B.	"Cotton Industry Activity Indices: Calculation"	272
Emerson, O. H. and G. A., and Evans, H. M.	"The Isolation from Cottonseed Oil of an Alcohol resembling Alpha Tocopherol from Wheat-Germ Oil"	257
Ergle, D. R.	"Carbohydrate Content of Cotton Plants at Different Growth Periods and the Influence of Fertilizers"	335
Esaki, T.	"Insects Injurious to Cotton in Mandated South Sea Islands of Japan: First Report"	338
Esselen, D.	"Does Cultivation Conserve Soil Moisture ?"	160
Ewing, K. P., and McGarr, R. L.	"Large-Scale Sulphur-Dusting Experiments for Cotton Flea Hopper Control at Port Lavaca, Texas"	340
	"Recent Insecticide Experiments to Control Cotton Flea Hopper at Port Lavaca, Texas"	340
Fahmy, T.	"Cotton Diseases in Egypt"	343
	"Immunity in Plants and Immunity to Fusarium Wilt in Cotton"	173
Farr, W. K.	"Cellulosic Fibres: Structure"	271
Fawcett, G. L.	"Notas sobre Algunas enfermedades del Algodonero"	344
Fedotova, T. E.	"Serological Method for the Determination of Varietal Resistance to Disease in Cotton"	78
Fick, J. C.	"Erosion Plant Growth and Soil Varieties"	159
Field, B. Lyon	"Cotton Buying and Ginning, Fiji"	241
Field, N., and Briggs, P. W.	"Suggestions to Managers of Ginneries"	70
Fisher, R. A.	"The Design of Experiments"	254
	"Has Mendel's Work been Rediscovered ?"	175
Folsom, J. W.	"Additional Notes on Little-Known Cotton Insects"	164
Fooshe, G. W.	"American Cotton in 1935-36"	62
Ford, H.	"The Use of Cotton in the Motor-Car Industry"	181
Foulkes, Col. W. A.	"Cotton Buying and Importing"	273

PAGE

FRAPPA, C. .. "Étude sur la Sauterelle Migratrice *Nomadacris septemfasciata* Serv. et sa Présence à Madagascar de 1926 à 1935" - 75
FREY, F. C., and SMITH, T. L. "The Influence of the AAA Cotton Programme upon the Tenant, Cropper and Labourer" - 326
FUCHS, V. R. .. "American Cotton Linters, Production and Quality" - 244
"Quality of Cotton Linters produced in the United States, Seasons 1934-36" - 327
FULTON, B. B. .. "Lead Arsenate and Wetting Agents for Corn Earworm Control" - 73

GAGE, S. H. .. "The Microscope" - 174
GAINES, R. C. .. "Boll Weevil Activity during Normal Hibernation Period at Tallulah, Louisiana" - 258
GAINES, J. C. .. "Cotton Flea Hopper Control Tests" - 340
GARRETT, S. D. .. "The Soil-Borne Fungus Diseases of Field and Plantation Crops" - 344
GATES, R. R. .. "Mutations and Natural Selection" - 267
GERALDES, C. DE M. "Remarques sur le Développement de la Culture du Cotonnier et les Méthodes de Production du Coton dans les Colonies Portugaises" - 330
GERDES, F. L., and BENNETT, C. A. "Effect of Artificially Drying Seed Cotton before Ginning on Certain Quality Elements of the Lint and Seed and on the Operation of the Gin Stand" - 71
GOKHALE, V. P. .. "Preliminary Observations on Small-Leaf Disease in Cotton" - 80
GOLDOWSKIJ, A. .. "The Principal Problems of Chemistry, Physico-Chemistry and Technology of Cottonseed Oil Production" - 256
GOLDOWSKIJ, A., *et al.* "The Factors determining the Colour of Cottonseed Cake" - 257
"The Rupture of the Cell Walls at the Cooking of Cotton, Sunflower and Linseed Meal" - 257
GOLDOWSKIJ, A., and MOLDAWSKAJA, S. "The Cottonseed Proteins and their Thermic Denaturation in the Production" - 256
GOLDOWSKIJ, A., and PODOLSKAJA, M. "The Behaviour of Gossypol in the Cottonseed Oil Production" - 257
GOULDEN, C. H. .. "Methods of Statistical Analysis" - 334
GREENE, H. .. "Soil Problems of the Anglo-Egyptian Sudan" - 250
"Water Duty Trials in the Sudan Gezira" - 57
GREGORY, F. G., and PURVIS, O. N. "Vernalization" - 354
GRIMES, M. A. .. "Cotton Fibre Tufts: Breaking Load" - 270
GROTE, A. .. .. "Cotton and Staple Fibre Yarns: Comparison" - 178
GRUMM-GRZIMAILO, A. G. "A Contribution to the History of the Introduction of Cotton Growing into China" - 64
GUHA ROY, K. K., and MAHALANOBIS, P. C. "Statistical Methods and their Application to Agronomy: A Bibliography" - 160, 254
GUILLIERMOND, A. .. "*L'Eremothecium ashbijii*, Nouveau Champignon Parasite des Capsules du Cotonnier" - 264
GULATI, A. N. .. "A Note on a New Type of Progressive Damage to the Structure of Cotton Hair caused by Micro-Organisms" 78
GUNDERMANN, J., WERGIN, W., and HESS, K. "Cotton Hair Primary Substance: X-ray Diagram and Constitution" - 356
GUREWITCH, M. .. "Anatomo-Microchemical Investigation of the Seed of Two Transcaucasian Types of Cotton" - 256
GUY, H. C. W. .. "Mixed Farming in East Africa. IV. The Value of Native Stocks" - 236

HAASE-BESSELL, G. "Chromatin, Chromosomen, Gene" - 176
HADDON, A. C., and START, L. E. "Iban or Sea Dayak Fabrics and their Patterns" - 180
HALDANE, J. B. S. "The Amount of Heterozygosis to be Expected in an Approximately Pure Line" - 88

		PAGE
Hale, G. A. ..	" The Effect of Variety, Planting Date, Spacing and Seed Treatment on Cotton Yields and Stands " - -	161
Hall, Sir Daniel	" The Improvement of Native Agriculture in Relation to Population and Public Health " - - -	235
	" The Menace of Soil Erosion " - - - - -	67
Hamid, A., and Mohammad, N.	" Preliminary Studies on the Effect of Delinting of Cotton Seed with Sulphuric Acid on Germination and Yield "	161
Hancock, H. A. ..	" Progress Report on the Spinning Test Station at Giza "	152
	" A Spinning Procedure for Cotton Samples " - -	356
	" Strength of Egyptian Cottons " - - -	242
	" Strength, Grade and Price of Egyptian Cottons " -	325
	" The Yarn Strength of Egyptian Cottons " - -	151
Hancock, N. I. ..	" Cotton Varieties and Related Studies in Tennessee " -	155
	" Row Competition and its Relation to Cotton Varieties of Unlike Plant Growth " - - - -	267
Hansford, C. G. ..	" Annotated Host List of Uganda Parasitic Fungi and Plant Diseases.—I. and II." - - - -	343
Harland, S. C. ..	" Duplicate Genes for Corolla Colour in *Gossypium barbadense* L. and *G. Darwinii* Watt " - -	82
	" Genetic Behaviour of a Mutant in a Trinidad Cotton Stainer (*Dysdercus urichi*) " - - - - -	76
	" The Genetics of Cotton. XVII. Increased Mutability of a Gene in *G. purpurascens* as a Consequence of Hybridization with *G. hirsutum* " - - -	267
	" Haploids in Polyembryonic Seeds of Sea Island Cotton "	87
	" Letter *re* " Rôle of Insects and Fungi in Agriculture " - - - - - - -	52
Harper, H. J. ..	" Studies on the Use of the Terracing Plough for Soil Conservation " - - - - - -	68
Harris, W. V. ..	" Annotated List of Insects injurious to Cotton in Tanganyika " - - - - - -	166
	" The Grey Field Mouse " - - - - -	261
	" Helopeltis Bug " - - - - - -	260
Hartley, C., and Rathbun - Gravatt, A.	" Some Effects of Plant Diseases on Variability of Yields " - - - - - - -	343
Hartley, K. T. ..	" Effect of Farmyard Manure in Northern Nigeria " -	333
Heim de Balsac, F., and Miege, E.	" Le Cotonnier Pima au Maroc " - - - - -	248
Hesketh, B. ..	" Reviving the Lancashire Cotton Industry " - -	273
Hess, K., *et al.* ..	" Cotton Hair: X-ray Investigation during Growth " -	178
	" Investigations on the Formation of the Cell Wall " -	355
Hess, K. P. ..	" Textile Fibres and their Use " - - - - -	180
Hesse, T. G. ..	" Cotton Marketing " - - - - - -	90
Heyward, F. ..	" Soil Sampling Tubes for Shallow Depths " - -	158
Hill, C. D. ..	" A Home-Made Terracing Implement " - - -	68
Himbury, Sir William	" Empire Cotton Growing: Development and Progress "	55
	" Maintenance of Empire Cotton Supplies " - -	145
Hindle, Son and Co., Ltd.	" A New Baling Press " - - - - - -	89
Holley, K. T., and Dulin, T. G.	" A Study of Ammonia and Nitrate Nitrogen for Cotton.—III. and IV." - - - - -	251
Hood, J. D. ..	" *Frankliniella gossypiana*, New Name " - - -	169
Hope, C., *et al.* ..	" The Effect of Crazy-top Disorder on Cotton Plants, and its Control by Irrigation Management " - -	263
Howard, Sir Albert	" The Manufacture of Humus from the Wastes of the Town and the Village " - - - -	334
	" The Restoration and Maintenance of Fertility " -	251
Howell, L. D., and Burgess, J. S.	" American Cotton: Farm Price, Grade and Staple " -	63
Hoyle, S. T. ..	" The Influence of Climate on *Dysdercus* spp. through their Wild Host Plants " - - - -	76
Hsu, C.	" The Influence on the Control of *Platyedra* (*Pectinophora*) *gossypiella* Saund. of Destroying the Infested Flowers " - - - - - -	339

		PAGE
HURD-KARRER, A. M.	"Selenium Absorption by Crop Plants as related to their Sulphur Requirement"	333
HURD-KARRER, A.M. and POOS, F. W.	"Toxicity of Selenium-containing Plants to Aphids"	340
HUSAIN, M. A., *et al.*	"Cell Sap Acidity and the Incidence of White-fly (*Bemisia gossypiperda*) on Cottons"	169
	"Studies on *Bemisia gossypiella*, M. and L. (White-fly of Cotton): Seasonal Activities in the Punjab"	77
	"Studies on *Schistocerca gregaria* Forsk."	75, 169
HUTCHINSON, J. B.	"Some Observations on the Inheritance of Form and Size in Asiatic Cottons"	82
HUTCHINSON, J. B., and GHOSE, R. L. M.	"The Classification of the Cottons of Asia and Africa"	353
	"On the Occurrence of 'Crinkled Dwarf' in *Gossypium hirsutum* L."	353
	"Studies in Crop Ecology. 1. The Composition of the Cotton Crops of Central India and Rajputana"	234
HUTCHINSON, J. B., and KUBERSINGH, —	"Studies in Plant Breeding Technique. I. An Analysis of the Efficiency of Selection Methods used in the Improvement of Malvi Cotton"	85
HUTCHINSON, J. B., and PANSE, V. G.	"An Examination of an Analysis of a Serial Experiment"	335
	"On an Attempt to use Hand-Spinning for Testing Quality in Cotton"	318
	"The Introduction of Improved Strains of Crop Plants in Central India and Rajputana"	54
HUXLEY, J. S. ..	"Natural Selection and Evolutionary Progress"	175
IMPERIAL BUREAU OF PLANT GENETICS, CAMBRIDGE	"The Experimental Production of Haploids and Polyploids"	87
IMPERIAL ECONOMIC COMMITTEE	"Industrial Fibres"	88
ISAKOVA, A. A. ..	"On the Problem of the Nature of the Action of Bacteriorhizal Micro-organisms of Plants"	344
ISLER, D. A. ..	"Engineering Phases of Pink Bollworm Control"	339
IVANOV, E. N. ..	"Bionomics and Ecology of the Moroccan Locust in Middle Asia"	342
JACK, R. W. ..	"Cotton Pests in Southern Rhodesia, 1936"	338
	"The Control of Tsetse Fly in Southern Rhodesia"	169
JENKINS, W. H. ..	"Sea Island Cotton in Puerto Rico and its Relation to Production in the Continental United States"	249
JENKINS, W. J. ..	"Recent Cotton Legislation in the Bombay Presidency"	206
JOFFE, J. S. ..	"Pedology"	249
JOHNSON, A. C., and HAWKINS, L. A.	"The Fumigation of Baled Cotton with Hydrocyanic Acid"	167
JOINT COMMITTEE OF COTTON TRADE ORGANIZATIONS	"Lancashire and the Future: The Present Position and Prospects of the Cotton Industry"	357
JONES, V. H. ..	"A Summary of Data on Aboriginal Cotton of the South-West"	327
KAMAL, M. ..	"Recent Advances in the Control of the Pink Bollworm (*Platyedra gossypiella* Saund.) by Natural Enemies"	338
KAPADIA, D. F. ..	"East African Cottons: Staple Length"	146
KAPSHUK, A. A. ..	"Tests of the Toxicity of Sulphur Compounds to the Group of Bacteria causing Rots of Vegetables and Spotting of Tobacco, French Beans, and Wheat, and Gummosis of Cotton"	264
KARUNARATNE, C. R.	"Agricultural Implements"	255
KAYUMOV, S. R. ..	"Tests against Cotton Pests of Some Plants that produce Essential Oils"	165

		PAGE
Kellogg, C. E.	"Development and Significance of the Great Soil Groups of the United States"	67
Kelsick, R. E.	"The Sea Island Cotton Industry in St. Kitts, Nevis and Anguilla"	242
Key, K. H. L.	"Rate of Locomotion in Relation to Starvation in *Locusta migratoria migratorioides* R. and F."	75
Killby, L. G.	"Helping to Build an Empire Industry"	1 *et seq.*
Knight, R. L.	"Letter *re* 'An Inexpensive Method of Selfing Cotton Flowers'"	231
Kobayashi, K.	"Studies on the Chemotropism of *Dysdercus megalopygus* Breddin"	169
Konstantinov, P. N., *et al.*	"Some Remarks on the Work of the Odessa Institute of Plant Breeding and Genetics"	354
Kostoff, D.	"Virus and Genic Reactions in Morphogenetic, Physiogenetic and Phytogenetic Aspects"	173, 266
Kosubutsky, M. I. and Stepantsev, I. N.	"Data on Pests and Diseases of Cotton Plants"	337
Krug, H. P.	"A Podridão Interna dos Capulhos do Algodoeiro no Estado de São Paulo"	171, 263
	"Second Contribution to the Geographical Distribution of Cotton Wilt (*Fusarium vasinfectum*) in Brazil"	349
Krug, H. P., and Mendes, L. O. T.	"The Incidence of *Platyedra gossypiella* and *Dysdercus* spp. and Various Cryptogamic Diseases in Cotton Bolls during June, 1936"	339
Kusebauch, K.	"Tiruppur-Cambodia Cotton: Characteristics"	144
Ladell, W. R. S.	"A New Apparatus for Separating Insects and Other Anthropods from the Soil"	72
LaCour, L.	"Improvements in Plant Cytological Technique"	354
Lamas, C.	"Los Insectos del Algodonero en los Valles de los Departmentos de Lambayeque y la Libertad (Peru)"	72
Lanham, W. B., *et al.*	"Quality of Cotton in Arkansas and Missouri, 1928-35"	328
Laycock, T.	"Cotton Seed Disinfection Experiments to Control Bacterial Diseases of the Cotton Plant"	78
Lazarev, N. V.	"A Possible Basis of Selecting Parents for Crossing"	267
Leach, J. G.	"Insects in Relation to Plant Diseases"	163
Lean, O. B.	"*Locusta migratoria migratorioides* R. and F. An Ecological Reconnaissance of the Suspected Middle Niger Outbreak Area"	75
Leontovitch, C.	"La culture du coton dans le district du Congo-Ubangi, 1933-35"	329
Leplae, E.	"La Bataille du Coton au Congo Belge"	247
Leppan, H. D.	"The Organization of Agriculture, with Applications to South Africa"	322
Leroy, J. V.	"Observations Relatives à quelques Hémiptères du Cotonnier"	260
Lesler-Smith, W. C.	"Soil Erosion"	251
Letoff, A. S., Eremeyeva, Mme. A. M., and Yablokova, Mme. V. A.	"Development of the Systematic Control of Cotton Pests and Diseases in Old-established Cotton-growing Districts (South-East Russia)"	164
Li, F.	"Pink Bollworm Problems"	166
Li, F.. and Ma, T.	"A List of Cotton Insects of the World"	72
Likhite, V. N.	"Host Range of the Gujarat Cotton Root Rot"	172
	"Stenosis in Gujarat Cotton"	172
Limoenkov, L. K.	"The Examination of Technical Effectiveness of Sulphur Preparations for Control against Cobweb Mite (Red Spider) in Different Geographical Points"	342
Lion, C.	"Japanese Cotton Industry: Competitive Power"	157
Lipscomb, J. F.	"Mixed Farming in East Africa. III. Starting a Dairy Herd in Kenya"	162
Liu, K.	"Notes on the Life-History of *Agrotis ypsilon* Rott. in Hangchow"	167
Liu, K., and Hwang, C.	"Biology of a Cotton Cutworm, *Agrotis* sp. in Hangchow"	168

		PAGE
LIVERA, E. J. ..	"Cotton Cultivation at Maho"	146
LOGAN, C. A. ..	"A Pasture Contour Furrowing Machine"	68
LOOMIS, W. E., and SHULL, C. A.	"Methods in Plant Physiology"	350
LOWDERMILK, W. C.	"Soil Erosion and its Control in the United States"	67
LYNN, C. W. ..	"Report on a Visit to Northern Nigeria to study Mixed Farming"	321
LYON, A. V. ..	"Maintaining the Productivity of Irrigated Lands"	336
LYSENKO, T. D. ..	"Intervarietal Crossing of Self-Pollinated Plants"	267
	"Some Remarks on the Work of the Odessa Institute of Plant Breeding and Genetics: A Reply to Criticisms by Konstantinov and Others"	345
MADHUSUDAN RAO, I., and WAD, Y. D.	"Leaf-Roll and Red Leaf of American Cottons"	81
MAHER, C.	"Mixed Farming in East Africa. II. Grassland and Arable Dairying in the Trans-Nzoia District, Kenya"	162
MANCE, SIR H. OSBORNE	"Co-ordination of Transport in Kenya, Uganda and Tanganyika Territory"	236
MARTIN, H. ..	"The Scientific Principles of Plant Protection, with Special Reference to Chemical Control"	77
MARTIN, S. W., and CLEAVES, F.	"Sampling American Cotton"	154
MARTIN, W. S., and BIGGS, C. E. J.	"Experiments on the Maintenance of Soil Fertility in Uganda"	240
MASON, T. G., and PHILLIS, E.	"The Concentration of Solutes in Sap and Tissue, and the Estimation of Bound Water"	83
	"The Migration of Solutes"	269
	"A Note on a New Method of Control for Insect Pests of the Cotton Plant"	308
	"Oxygen Supply and the Activation of Diffusion"	83
MASSEY, R. E. ..	"Seed Disinfection, with Special Reference to Cotton"	301
	"Sudan: Cotton Diseases, 1934-35"	170
MATA, C. G. ..	"Estudio Economico de la Produccion y Consumo de Aceites Comestibles (Edible Oils) en la Argentina"	163
	"La Economia Algodonera Norteamericana"	328
MATHUR, C. B., and SONI, B. N.	"Studies on *Schistocerca gregaria*, Forsk."	342
MAY, J. C., and KILLBY, L. G.	"An Appreciation of the Late Sir James Currie"	185
MAYO, J. K. ..	"Immaturity in Northern Nigerian Cotton"	86
MCCONNELL, R. J.	"Cotton and Spinning Machinery Testing"	89
MACORMAC, A. R., and CAMERON, F. K.	"Cotton Plant Pulps: Production"	271
MACGILL, E. I. ..	"The Biology of the Thysanoptera with Reference to the Cotton Plant. VIII. The Relation between Variations in Temperature and the Life Cycle"	257
MCKINNEY, R. S., and JAMIESON, G. S.	"Cottonseed Lint: Determination"	88
MCKINSTRY, A. H.	"Notes from the Cotton Station, Gatooma, Southern Rhodesia, 1936"	147
MEEK, DR. D. B. ..	"Report on the Work of the Indian Trade Commissioner during 1935-36"	142
MEHTA, N. C. ..	"Locusts"	260
MEISSAKHOVITCH, J. A., and MEDVEDEFF, I. D.	"Mechanization of Cotton Seed Disinfection with Formalin"	335
MELOY, G. S. ..	"American Cotton Linters: Standardization"	63
MENDES, L. O. T. ..	"A Lagarta das Macas do Algodoeiro, *Chloridea virescens* Fab."	340
	"Os 'Manchadores' do Algodão (*Dysdercus* spp.)"	263
MERRILL, G. K. ..	"I. Cotton Opening and Picking. II. Cotton Drawing and Roving"	179
	"Cotton Spinning Mills: Machinery Requirements"	271
	"Cotton Spinning Mill: Organization"	89

PAGE
Meyer, P. .. .. "Cotton Yarn: Strength Calculation" - - - 180
Miles, L. E. .. "Potash and Cotton Wilt in Central and North Mississippi" - - - - - - - 264
"Potash for Cotton Wilt and Rust in South Mississippi" 173
Miles, L. G. .. "Back-crossing and its Use in Plant Breeding" - - 175
Milligan, S. .. "Some Cotton Problems of South Africa" - - 189
Milner, C. D. .. "The Raw Cotton Trade" - - - - - 182
Mirer, E. .. .. "The Carbohydrates of the Cotton Seed" - - 257
Mitra, M., and Kheswalla, K. F. "The Effect of Temperature on the Growth of *Fusarium vasinfectum*, Atk." - - - - - - 173
Mitra, R. .. .. "On the Nature of Reactions Responsible for Soil Acidity.—Part V." - - - - - - 67
Morris, M. H. .. "Injurious Insects of Cyprus" - - - - 72, 257
Muirhead, D. M. .. "Problems in Termite Control" - - - - - 342
Mukherjee, J., *et al.* "On the Nature of Reactions responsible for Soil Acidity.—Part IV." - - - - - - 67
Munro, J. W. .. "Recent Advances in Fumigation and the Needs of Fumigation Practice" - - - - - 254
Murphy, H. F., *et al.* "Field Crops Experiments, Oklahoma, 1934-36" - 246

Nasmith, F. .. "Taking Stock: Lancashire's Present and Future Position in Textiles" - - - - - 357
Nawaschin, M. S. "Untersuchungen über die Natur der Mutationen" - 177
Neal, D. C., and Collins, E. R. "Concentration of Ammonia necessary in a Low Lime Phase of Houston Clay Soil to Kill the Cotton Root Rot Fungus (*Phymatotrichum omnivorum*)" - - 347
Neelakantam, K., and Seshadri, T. R. "Cotton Flower Pigments: Composition" - - 269
Neelakantan, L., and Kontareddy, G. "Seedling Abnormalities in Cotton" - - - - 350
Nelson, M., *et al.* .. "Agronomic Research: Arkansas" - - - - 327
Neumann, N. .. "The State of the Oil in the Protoplasm of Oil-Seed and the Dyeing of Oil in the Cell" - - - - 257
Nickson, A. C. .. "The Cotton Association: Contracts for Every Variety" 181
Nikol'skii, V. V., *et al.* "Ecologo-Economic Basis and Development of a System of Control Measures against Pests and Diseases in the Established Cotton-Growing Districts, Uzbekistan" - - - - - - - - 342
Nikolyuk, — .. "Technical Effectiveness of Sulphur Preparations against Cobweb-mite (Red Spider)" - - - 342
Norris, P. K. .. "Cotton Production" - - - - - - 158
Novak, V. .. .. "A Brief Review of the Development of the Mechanical Analysis of Soils" - - - - - - 67
Nowell, W. .. "The First Ten Years of the Amani Research Station" 101
"The Work of the Experiment Stations, Season 1935-36. An Explanatory Review" - - 145

Odriozola, M. E. "The Significance of the Fungus Disease Cotton Wilt, in Peru" - - - - - - - 264
Ogden, H. P., *et al.* "Field Crops Experiments, Tennessee, 1935" - - 246
O'Kelly, J. F., and Hull, W. W. "Effects of Delayed Harvesting by Picking and Snapping on Six Varieties of Cotton" - - - - 256
Onodera, J. .. "Studies in the Correlation among the Characters of Asian Cotton Varieties and their F_2 Hybrids" - 177

Pearse, N. S. .. "Cotton Progress in Brazil" - - - - - 329
Peat, J. E. .. "Some Notes on Cotton Growing in Southern Rhodesia" 56
Peirce, F. T. .. "What Kind of Cotton *do* they Want?" - - 286
Peiris, H. A. .. "A Note on the Cotton Purchase Scheme, 1936" - 320
Peltier, G. L. .. "Distribution and Prevalence of Ozonium Root-rot in the Shelter Belt Zone of Texas" - - - 347
Penny, N. M. .. "Grade and Staple Length of Cotton Produced in Georgia, 1928-35" - - - - - - 63
Peterson, A. .. "A Manual of Entomological Equipment and Methods" 336

Phillis, E.	"Progress in Physiology"	117
Phillis, E., and Mason, T. G.	"The Effects of Light and Oxygen on the Uptake of Sugar by the Foliage Leaf"	352
	"Interchange between the Tissues of the Corolla"	84
Phipps, I. F.	"Recent Developments in Genetics and Plant Breeding"	175
Pickard, Sir Robert	"The British Cotton Industry Research Association: The Work of the Shirley Institute"	55
Pignarre, M.	"La Culture du Coton en Syrie en 1935"	157
Pilavachi, G.	"Breeding and Propagation of New Cotton Varieties in Egypt"	151
	"Latest Developments in Ginning and Steam Pressing in Egypt"	151
Pilette, M.	"L'Egrenage du Coton"	256
Pitcairn, A.	"Irrigation in Cyprus"	55
	"Soil Erosion in Cyprus"	332
Pittery, R.	"Quelques Données sur l'Experimentation Cotonnière: Influence de la Date des Semis sur le Rendement"	161
Platt Bros. and Co., Ltd., and Leech, I.	"Double Cotton Gin"	162
Plauche, H.	"American Cotton Industry, 1935-36"	61
Pletsch, D. J.	"Improved Device for Artificial Feeding of Aphids"	340
Podolskaja, M.	"The Influence of Gossypol on the Colour of Cottonseed Oil"	257
	"The Red Gossypol"	257
Pope, O. A.	"Length-Diameter Relationships in Cotton Fibre"	270
Porter, D. D.	"Positions of Seeds and Motes in Locks and Lengths of Cotton Fibres from Bolls borne at Different Positions on Plants at Greenville, Texas"	86
Preston, J. M.	"Section Cutting by a Modified Plate Method"	88
Prindle, B.	"Mildewed Cotton Fibres: Microscopy"	178
Proctor, J. W.	"Japanese Cotton Industry: Development and Trade with America"	248
Puri, A. N.	"Dispersion of Soil for Mechanical Analysis of Sodium Carbonate or Sodium Oxalate Treatment"	331
Quinby, J. R., *et al.*	"Competition between Cotton Varieties in Adjacent Rows"	335
Raillo, Mme., A. I.	"Diagnostic Evaluation of the Morphological and Cultural Characters in the Genus *Fusarium*"	172
	"Taxonomy of the Genus *Fusarium*, and a Method for the Determination of the Species belonging to it"	348
Rainwater, C. F.	"Further Studies on Cotton Root Aphid"	167
Ramakrishnan, S.	"On the Correlation of Weather Conditions and Yield of Kumpta Cotton, Dharwar District"	319
Ramchandra Rao, Y.	"The Locust Incursion of 1935 in North-West India: Its Significance in the Study of the Locust Problem"	168
Ransomes, Sims, and Jefferies, Ltd.	"Cultivation Machinery"	255
Ravet, A.	"La Ferme Indigène"	329
	"L'Organisation de la Culture Cotonnière au Congo Belge"	155
Rau, N. S.	"Sea Island Cultivation in Kanara"	144
Reddis, A. K.	"The Inquiry on the Effectiveness of the System of Measures for Control of Cotton Pests and Diseases"	337
Reeves, R. G.	"Comparative Anatomy of the Seeds of Cottons and other Malvaceous Plants, I, II."	350
Reeves, R. G., and Beasley, J. O.	"Localization of Pentosans in the Resin Glands of the Cotton Embryo"	352
Revere, C. T.	"Outlook for the New American Crop"	62
Richards, H. I.	"Cotton and the A.A.A."	62
Richardson, R. P., and Ahmad, N.	"Further Tests on Indian Cottons with Different Systems of High Draft Spinning"	318
Richmond, T. R., and Fulton, H. J.	"Variability of Fibre Length in a Relatively Uniform Strain of Cotton"	270

PAGE
Riker, A. J., and R. S. " Introduction to Research on Plant Diseases: A Guide to the Principles and Practice for Studying Various Plant-Disease Problems " - 262
Ritchie, A. H. .. " Cotton Pests in Tanganyika, 1935 " - 258
Rjabov, N. M. .. " Theoretical and Practical Importance of Seed Rejuvenation " - 177
Robb, A. E. .. " An Investigation on the Rôle of Parasites of Eggs and Larvæ of *Chloridea obsoleta* " - 341
" Study on Control Measures against *Chloridea obsoleta* " 341
Robert, J. C., and Greer, S. R. " Field Crops Experiments at the South Mississippi Sub-Station, 1932-35 " - 63
Rodicev, S. A. .. " On Pure Lines " - 176
Roe, J. W. .. " Cotton Gin: History " - 70
Roehrich, O. .. " Raw Cotton: Colour " - 174
Rogers, C. H. .. " Cotton Root-Rot and Weeds in Native Hay Meadows of Central Texas " - 347
Rossi, G., *et al.* .. " Dried Microscopic and Bacteriological Examination of the Soil " - 67
Rotleider, M. A. " Soviet Cotton Crop: Yield and Quality " - 158
Roubaud, E. .. " Recherches Expérimentales sur le Criquet Pélerin. II. La Livrée Hibernale et les Migrations Réactivantes de la Phase Grégaire " - 75
Ruprecht, P. .. " Japanese Cotton and Rayon Industries: Competitive Power " - 248
Russell, Sir John " Soil Conditions and Plant Growth " - 330

Sakostschikoff, A. " Vegetable Fibres: Structure " - 178
Salaman, R. N. .. " Immunity to Virus Diseases in Plants " - 173
Salt, G. .. .. " Experimental Studies in Insect Parasitism. IV. The Effect of Super-Parasitism of Populations of *Trichogramma evanescens* " - 343
Sampson, H. C. .. " Some Reminiscences of Work on the Cotton Crop " - 294
Sanders, G. E. .. " Termite Control in North-Eastern United States " - 342
Sands, W. N. .. " The Sea Island Cotton Industry " - 241
Sarejanni, J. A., and Cortzas, C. B. " La Nature de la Résistance du Coton au *Macrophomina phaseoli* (Maubl.), Ashby " - 346
" Note sur le Parasitisme du *Macrophomina phaseoli* (Maubl.), Ashby " - 81
Savulescu, T. .. " L'Immunité aux Maladies Bactériennes des Plantes " 170, 343
Schneider, A. .. " Brazilian Cotton: Production and Export in 1936 " - 156
Schwarz, E. R. .. " Cotton Fibre: Maturity Determination by the Polarising Microscope " - 269
Sen, K. R., and Afzal, M. " Variations in the Character of Cotton in Relation to the Position of Bolls on the Plant " - 269
Serbinov, V. I. .. " The Mass Infection of Cotton Bolls in the Khorezin Oasis " - 337
Setzer, R. .. " Cotton Yarns: Moisture Relations " - 179
Shaw, F. J. F. .. " A Handbook of Statistics for Use in Plant Breeding and Agricultural Problems " - 266
Shaw, L. .. .. " Cotton Diseases in North Carolina during the Season of 1936 " - 343
Sheffield, F. M. C. " The Early Development of the Cotton Fibre " (Errata) 91, 141, 182
Shinji, O. .. .. " On the Aphids of Cotton at Moppo, Korea " - 167
Shrikhande, J. G. " Utilization of Certain Forms of Inorganic Nitrogen during the Decomposition of Plant Materials in the Soil " - 69
Singh, B. N., and Choudhri, R. S. " The Rôle of ' Deflowering ' in Cotton Production " - 126
Skeete, C. C. .. " Memorandum on Precautionary Measures against the Introduction of the Cotton Boll Weevil into the Islands of the Eastern West Indies, and Recommendations in Respect of the Action to be taken by the Governments of all the Islands " - 338
Skinner and Co. " Cotton Trade Directory of the World, 1936-37 " - 90

PAGE
Skovsted, A. .. “Cytological Studies in Cotton. Pt. IV. ‘Chromosome Conjugation in Interspecific Hybrids’” - - 268
Slater, W. H. .. “American Cotton Prospects: Increasing ‘Outside Growths’ to be taken into Account” - - - 326
“Cotton Supplies and Prices” - - - - - 90
Slattery, E. .. “Flax-Like Cotton Fibres: Distinction from Flax Ultimate Fibres” - - - - - - 270
Sloan, W. J. S. .. “The Cotton Web-Spinner” - - - - - 260
Smee, C. .. .. “The Report of the Entomologist, Nyasaland, 1935” - 258
Smith, F. H. .. “The Problem of Comparing the Results of Two Experiments with Unequal Errors” - - - 160
Smith, G. L., and Young, M. T. “Field Movement of Boll Weevils in Relation to Initial Infestation and Rainfall” - - - - - 259
Smith, G. R. .. “Cotton Marketing Practices: North Carolina” - - [illegible]3
“Gin Damage of Cotton in Relation to Rainfall” - 256
Smith, H. G. .. “Cotton Cultivation in Latin America” - - - 328
Smith, H. P. .. “Fertilizer Placement Studies with Cotton, 1935” - 246
Smith, H. P., *et al.* “Chemical Dust Treatment of Cotton Seed for Planting Purposes” - - - - - - - - 255
Smith, K. M. .. “Recent Work on the Plant Viruses” - - - 265
Sosnina, M. A. .. “Brief List of Cotton Insect Pests in Southern Tadjikistan” - - - - - - - 337
“Study of the Cotton Bollworm (*Chloridea obsoleta*, F.)” 337
Southern Textile Association “Spinning Problems: Discussion” - - - 89
Soyer, L. and D. “Rapport Technique Annuel de la Station de Sélection de Gandajika (Belgian Congo) pour la Campagne, 1935” - - - - - - - 156
Spalding, T. .. “Early Days of Cotton Growing in the U.S.A.” - 41
Spencer-Smith, J. L., and Todd, H. A. C. “An Abbreviated Method and a Suggested Cheap Mechanical Device for calculating the Standard Deviations of Observations” - - - 254
Squire, F. A. .. “Cotton Pest Investigations in the Windward and Leeward Islands” - - - - - - 258
“Report on a Visit to Montserrat” - - - 150
Stedronsky, V. L. “Power Requirements in Cotton Ginning Plants” - 70
Stepantzev, I. N. “Control of *Epitetranychus althææ*” - - - 342
“The Effect of Acacia Aphid (*Aphis laburni* Kal.) on the Development and Yield of Cotton” - - - 337
Stevenson, J. A., and Cash, E. K. “The New Fungus Names proposed by C. G. Lloyd” - 344
Steyaert, R. L. .. “Étude des Facteurs Météorologiques Régissant la Pullulation du *Rhizoctonia solani* Kuhn. sur le Cotonnier” - - - - - - - 79
“Le Port et la Pathologie du Cotonnier: Influence des Facteurs Météorologiques” - - - - 174
Stiles, W. .. .. “An Introduction to the Principles of Plant Physiology” 349
Strang, P. M. .. “American Cotton Textile Industry Changes, 1900-1936” 327
Strel’nikov, I. D. “Effect of Solar Radiation and Micro-climate upon the Body Temperature and Behaviour of the Larvæ of *Locusta migratoria*” - - - - - - 75
Stroer, W. F. H. .. “The Gene, its Function and its Meaning in Genetics” - 177
Subramanyan, V. “Determination of Nitrogen in Soil” - - - 69
Svelasov, A. T. .. “Breeding in the Campaign for Lint Quality in Cotton” 350
Sweetman, H. L. .. “The Biological Control of Insects” - - - 257
Swynnerton, C. F. M. .. .. “The Tsetse Flies of East Africa: A First Study of their Ecology with a View to their Control” - 262
Szymanek, J. F. .. “Croisement Interspécifique des Cotonniers: Note Complémentaire” - - - - - - 177

Taubenhaus, J. J. “Phymatotrichum Root Rot on Winter and Spring Weeds of South Central Texas” - - - 172
Taubenhaus, J. J., and Christenson, L. D. “Rôle of Insects in the Distribution of Cotton Wilt caused by *Fusarium vasinfectum*” - - - 264

PAGE

Taylor, T. H. C. .. “Investigation of *Platyedra gossypiella* (Pink Bollworm) in Uganda” - 339
Tennyson, G. .. “Invasion of Cotton Seed by *Bacterium malvacearum*” - 344
Ter-Zakharyan, K. O. .. “Comparative Tests on the Susceptibility of Different Cotton Varieties to the Attack of Red Spider” - 337
Thadani, K. I. .. “Some Notes on the Incidence of Disease and Resistance to Pathological and Other Adverse Conditions in Crops of Sind” - 263
Thaka, B. J., and Amin, K. C. “Interspecific Hybridization in Cotton” - 177
Thomas, H. A. .. “Australian and American Cotton: Dyeing Properties” - 272
Thompson, A. W. “Spinning Room: Value of Controlled Humidity” - 89
Thompson, W. R. “Moisture and Farming in South Africa” - 322
“Rainfall, Soil Erosion and Run-off in South Africa” - 159
Tibilova, A. A. .. “Life History of the Cotton Red Spider” - 337
Timson, S. D. .. “Kraal Manure: A Simple Method of Increasing the Supply” - 160
“Compost: A Note on Methods of Reducing the Costs” 333
“Natural Protection from Soil Erosion” - 332
Tissot, P. .. .. “La culture du cotonnier au Brésil” - 330
Todd, J. A. .. “American Cotton Restriction and its Effect on Outside Growths” - 110
“Cotton Statistics” - 45, 134, 221, 310
“The New Egyptian Cotton Contract in Liverpool” - 61
Tondeur, G. .. “Rapport de la Station de Sélection Cotonnière de Bambesa” - 247
Tong, W., and Tu, S. “A Study of Farm Economy in China through an Analysis of Farm Accounts in Selected Districts” 247
Trinchieri, G. .. “Il ‘Verme Rosa’ del Cotone in Italia” - 339
Trought, T. .. “Cotton Growing and Breeding in the Anglo-Egyptian Sudan” - 197
“Cotton Research Work, Sudan, 1934-35” - 148
Tucker, R. W. E. “Parasites Introduced for the Control of Insect Pests in Barbados” - 72
Turner, A. J. .. “Irregularity of Cotton Yarns” - 271
Turner, N. .. “Relation of State Workers to Commercial Termite Control Companies” - 342

Uichanco, L. B. .. “Secular Trends of Locust Outbreaks in the Philippines and the Apparent Relation with Sunspot Cycles” - 261
Union Castle Mail Steamship Co., Ltd. “The South and East African Year Book and Guide for 1937” - 91
Uppal, B. N. .. “Cotton Diseases, Bombay, 1934-35” - 79
Uvarov, B. P., and Hamilton, A. G. “Phase Variation and Rate of Development in the Algerian Race of the Migratory Locust (*Locusta migratoria*, L.)” - 75

van Vuren, J. P. J. “The Problem of Wind-eroded Lands” - 251
Vasudeva, R. S. .. “Studies on the Root-rot Disease of Cotton in the Punjab. II. Some Studies in the Physiology of the Causal Fungi” - 79
“Studies on the Root-rot Disease of Cotton in the Punjab. III. The Effect of some Physical and Chemical Factors on Sclerotia Formation” - 348
Vavilov, N. I. .. “The Study of Immunity of Plants to Infectious Diseases” - 78
Vayssière, P. .. “État des Recherches sur les Sauterelles Migratrices” - 261
Verdeeevska, D. D., Lebrdeva, O. P., *et al.* “Gummosis of Cotton: Materials for the Elaboration of a System of Control Measures” - 345
Visva Nath, B. .. “Science and Practice of Agriculture in India” - 318
Vock, F. .. .. “Volkart Double Roller Gin” - 162
von Bergen, W. .. “Fibre Cross-sections: Preparation” - 355
Vzoroff, V. I. .. “Bactericidal Properties of Hydrogen Sulphide” - 171

WATKINS, G. M. .. “Penetration and Invasion of *Phymatotrichum omnivorum* on Cotton Roots grown under Pure Culture Conditions” - 347
WAELKENS, M. .. “La Campagne Cotonnière, 1935-36: Belgian Congo” - 247
“La Purification du Triumph Big Boll dans l’Uele” - 174
“Travaux de Sélection du Coton” - 176
WAGNER, M. .. “Russian Textile Industry: Economics” - 66
WAKSMAN, S. A. .. “Humus: Its Origin, Composition and Importance in Nature” - 68
“Soil Microbiology” - 331
WARE, J. O. .. “U.S. Yearbook of Agriculture, 1936; Cotton Section” - 243
WATSON, G. H. .. “Cotton Road-Making Fabrics: Application” - 181
WATSON, M. A. .. “Factors affecting the Amount of Infection obtained by Aphis Transmission of the Virus Hy. III.” - 266
WATTS, J. G. .. “South Carolina: Cotton Pests” - 166
“A Study of the Biology of the Flower Thrips *Frankliniella tritici* (Fitch), with Special Reference to Cotton” - 77
WEBBER, J. M. .. “Cotton Plant: Genetics” - 176
WELLS, W. G. .. “Thinning and Spacing of Cotton” - 241
“The Value of Grassland Cultivations in Cotton Rotations” - 69
WERGIN, W. .. “Cotton Hair: Development and X-ray Structure” - 271
WILLE, J. .. .. “Plagas del Algodonero en la Campaña Agricola, 1935-36” - 165
WILLE, J. E., *et al.* “El Arrebiatado y Otros Insectos Daninas al Algodonero en los Valles del Norte del Peru” - 258
WILLIAMS, T. C. .. “Opening and Cleaning Machinery” - 272
WINDEL, D. .. “The Egyptian Cotton Section of the Lancashire Cotton Industry in the 1935-36 Season” - 151, 182
“The Rise in World Cotton Consumption” - 90
WISHART, J. .. “The Evolution of the Field Experiment” - 160
WOO, F. C., and CHENG, T. S. “A General Investigation of the Locust Outbreaks in China during 1935” - 168
WOOD, R. C. .. “A Notebook of Tropical Agriculture” (2nd edition) - 357
“Village Waste” - 160
WOOLF, D. G. .. “American Cotton Textile Institute: Foundation and Work” - 244
WRIGHT, J. W., and LANHAM, W. B. “Rates for Ginning and Wrapping American Cotton and Related Data, Seasons 1928-29 to 1935-36” - 244
WRIGHT, J. W., and McLURE, J. H. “The Distribution of American Raw Cotton, Season 1932-33” - 243

YANG, Y. K. .. “Suggestion of a New Formula for the Deviation of the Mean Method” - 254
YATES, F. .. .. “Incomplete Randomized Blocks” - 334
“A New Method of Arranging Variety Trials involving a Large Number of Varieties” - 69
YEHRA, M. ALI .. “A Note of the Outlets for Egyptian Cotton by Countries and Varieties” - 61
YOUNG, V. H. .. “Fertilize to Control Cotton Wilt and Rust” - 173
YOUNG, V. H., and HUMPHREY, L. M. “Arkansas: Cotton Wilt Studies” - 349

ZOLOTAREV, E. K. “Conditions of Existence and Individual Variability in the Asiatic Locust *Locusta migratoria*” - 168
ZOLOTAREVSKY, B. N. “Compte-rendu Sommaire sur les Recherches de la Mission d’Études de la Biologie des Acridiens dans la Région du Tchad en 1935” - 169
ZUKOVSKII, P. M... “On the Cotton Regions of Azerbaijan” - 330

GENERAL INDEX TO VOL. XIV.

574 A cotton, 148
Abbassi cotton, 197
ABYSSINIA, 246
Acacia aphid (*Aphis laburni*). See Pests
Acala cotton, 62, 155, 162, 243, 327, 346
AFGHANISTAN, 85, 295
Afifi cotton, 199
African Busoga cotton, 318
"Agricultural and Animal Husbandry in India, 1933-34 and 1934-35" new title for "Review of Agricultural Operations in India," 233
"Agricultural Implements" (Karunaratne), 255
Agricultural Outlook Charts, 1937, 182
Agricultural Research Institutes in the U.K., Rpts. on the Work of, 1934-35, 320
Agricultural Statistics, 1936, America, 243
Agricultural Workers in the British Empire, 1936: List of, 145
Agrotis sp. *Agrotis ypsilon*. See Pests
ALABAMA. See AMERICA
Alabama argillacea (Cotton Leafworm). See Leafworm under Pests
Allen Cotton, 157
Amani Research Institute Fifth Ann. Rpt., 1935-36, 148; Conference on Co-ordination of Agr. Research in East African Territories, 1936, 76; "The First Ten Years of Amani" (Nowell), 101
Ambassador cotton, 266
AMERICA:
  "Aboriginal Cotton of the Southwest: A Summary of Data on" (Jones), 327; Agricultural Adjustment Act, 62; Agricultural Outlook Charts, 1937, 182; Agricultural Statistics, 1936, 243; "Community Cotton Growing," 62; "Cotton and the AAA" (Richards), 62; "Cotton Fabric for Use in Road Making" (Cheatham and Whitaker), 89; "Cotton Investigations in 1936" (Barre), 154; "Cotton Linters, Quality of, in Seasons 1934-36" (Fuchs), 327; "Cotton Varieties and Related Studies" (Hancock), 155; "Development and Significance of the Great Soil Groups of the U.S." (Kellogg), 67; diseases in, 79, 80, 171, 172, 173, 245, 263, 264, 343, 347, 349; "Distribution of American Raw Cotton, Season 1932-33" (Wright and McLure), 243; dusting experiments, 173; "Early Days of Cotton Growing in," 41; "La Economia Algodonera Norteamericana" (Mata), 328; "Engineering Phases of Pink Bollworm Control" (Isler), 339; "Farm Compost" (Albrecht), 334; fertilizer experiments 154, 244, 245, 246, 334, 335; "Gins: Care and Maintenance of" (Bennett and Gerdes), 336; ginneries, 62, 328; "Ginning of Cotton in," papers by M. Pilette, 256; "Ginning Investigations" (Bennett), 70; (Bennett and Gerdes), 70; (Gerdes and Bennett),71; "Ginning: Rates for" (Wright and Lanham), 244; "Government Control of Cotton Production, 1933-35" (Day), 153; "Improved Cotton Varieties: Registration of" (Brown), 266; "Influence of the AAA Cotton Programme upon the Tenant, Cropper and Labourer" (Frey and Smith), 326; legislation to control pink bollworm, 181; "New Cotton Picker" (Rust Bros.), 70, 163; "One-Variety Cotton Communities" (Barre), 154; parasites, 166, 168; pests in, 73, 74, 77, 163, 164, 165, 166, 167, 168, 181, 246, 258, 259, 264, 339, 340, 341, 342; "Phytopathological and Physiological Studies in," 80; picking machinery, 70, 163; prices, 47, 51, 136, 140, 223, 229, 317; "Research with Field Crops in the Bureau of Plant Industry," 327; "Seed, Ceresan Treatment of, for Planting Purposes" (Smith *et al.*), 255; "Seed (Stored): Pests Attacking" (Bissell), 165; "Selenium Occurrence in Soils" (Byers), 333; "Soil Conservation: Use of Terracing Plough for" (Harper), 68; "Soil Erosion and Its Control" (Lowdermilk), 67; "Soil Sampling Device" (Heyward), 158; soils, 67, 333; spinning problems: discussion on, 89; statistics, 45, 48, 135, 136, 139, 140, 221, 226, 243, 310, 314, 315, 316, 317; varieties of cotton, 154, 155, 243, 244, 266; Yearbook of Agriculture, 1936, 153, 243. *Alabama:* 244. *Arizona:* diseases in, 171, 263; field crops experiments, 1935, 245; Hopi cotton, 62, 88. *Arkansas:* agronomic research, 245, 327; diseases in, 245, 349; "Plantation Operations of Landlords and Tenants" (Blalock), 327; "Quality of Cotton in 1928-35" (Lanham *et al.*), 327. *Connecticut:* 245. *Florida:* 245. *Georgia:* community cotton growing, 62; cotton experiments,

1935-36, 154; "Effect of Variety Planting Date, Spacing and Seed Treatment on Cotton Fields and Stands" (Hale), 161; "Grade and Staple Length of Cotton Produced, 1928-35" (Penny), 63; pests in, 73, 168. *Louisiana:* "Boll Weevil Activity during Normal Hibernation Period at Tallulah" (Gaines), 258; Field Crops Experiments, 1935, 155; "Field Movement of Boll Weevils in Relation to Initial Infestation and Rainfall" (Smith and Young), 259; pests in, 164, 258; 259. *Mississippi:* diseases in, 264; "Dusting Experiments" (Dunnam), 173; "Field Crops Experiments at South Mississippi Station, 1932-35" (Robert and Greer), 63; "Potash for Cotton Wilt and Rust" (Miles), 173. *Missouri:* 327, 334. *New Mexico:* 63. *North Carolina:* "Cotton Marketing Practices" (Smith), 63; "Diseases in 1936" (Shaw), 343; investigation on gin damage of cotton in relation to rainfall, 256. *Oklahoma:* "Farmer Suggested Changes in Farm Organization, etc.," 155; "Field Crops Experiments, 1934-36" (Murphy *et al.*), 246; pests in, 246; "Regulation of Cotton Gins as Public Utilities" (Ballinger), 62; "Rpt. on the Production of Cotton in the Panhandle of Oklahoma" (Daniel), 328; "Soil Conservation: Use of Terracing Plough for" (Harper), 68; "Some Economic Problems of Cotton Gins in" (Ballinger and Soxman), 328. *South Carolina:* diseases in, 79; pests in, 77, 166. *Tennessee,* 155, 246. *Texas:* agronomic research, 63; "Ceresan Treatment of Seed for Planting Purposes" (Smith *et al.*), 255; diseases in, 80, 172; "Fertilizer Placement Studies with Cotton, 1935" (Smith), 246; pests in, 74, 259, 340; "Seeds and Motes: Position of, in Locks and Lengths of Cotton Fibres from Bolls borne at Different Positions on Plants at Greenville" (Porter), 86

American bollworm. See *Heliothis obsoleta* under Pests

American cotton: "American Cotton in 1935-36" (Fooshe), 62; environment may change characteristics, 326; "Farm Price, Grade and Staple" (Howell and Burgess), 63; fibre fineness of, 326; "Financing Production and Marketing" (Benton), 63; "Hairiness of, in the Punjab" (Afzal), 86; improved American cotton cultivation, 243; new uses for, 273; "Outlook for the New American Crop" (Revere), 62; "Present Position of" (Cox), 153; prices (futures), 47, 51, 136, 140, 223, 229; (spot), 47, 51, 136, 140, 223, 229; "Progress in Improving the Quality of" (Black), 62; "Rates for Ginning and Wrapping, Seasons 1928-28 to 1935-36" (Wright and Lanham), 244; "Review of 1935-36," 62; "Sampling of" (Martin and Cleaves), 154

American Cotton Belt Agricultural Policy, 326

"American Cotton Industry, 1935-36" (Plauche), 61

"American Cotton Linters: Production and Quality" (Fuchs), 244; "Standardization of" (Meloy), 63

"American Cotton Prospects: Increasing Outside Growths to be taken into Account" (Slater), 326

"American Cotton Restriction and its Effect on Outside Growths" (Todd), 110 *et seq.*

"American Cotton Textile Industry Changes, 1900-1936" (Strang), 327

"American Cotton Textile Institute Foundation and Work" (Woolf), 244

"American Raw Cotton: Distribution of, Season 1932-33" (Wright and McLure), 243

"America (Latin), Cotton Cultivation in" (Smith), 328

"The Amount of Heterozygosis to be Expected in an Approximately Pure Line" (Haldane), 88

ANGUILLA. See WEST INDIES.

Angular Leaf Spot. See Diseases

Annual Cotton Handbook, 1936, 90

Anomis luridula. See Pests

Anthonomus vestitus. See Pests

ANTIGUA. See WEST INDIES

Antilles cotton, 324

Apanteles sagax, A. sylepta, A. Thurberiæ. See Parasites

Aphids. Aphis gossypii. See Pests

Aphis laburni. See Acacia Aphid under Pests

Apion xanthostylum. See Weevil Stem Borer under Pests

Appointments, 183, 358

Areolate Mildew. See *Ramularia areola* under Diseases

ARGENTINA:
  "Boletin Informativo," Nos. 16, 18, 19 and 20, 246; "Censo Algodonero de la Republica Argentina, 1935-36," 246; Coker varieties of cotton under cultivation, 246; cotton crop prospects, 1936-37, 328; cotton cultivation folders, 155; cotton industry, 1935-36, 64; cotton industry, plan for expansion of, in 1936-37, 155; "Cottonseed Oil Production and Consumption" (Mata), 163; diseases in, 344; "El Costo de produccion del Algodon en 1935-36," 328; "Locust Investigations: Rpts. of Central Commission," 261; pests in, 64, 261; prices in 1934-35, 155; "Tanguis Cotton: Selection Work with, in Cañete" (Correa y Elias), 351; "Los Trabajos Ecologicos Algodoneros en el Ano 1935-36," 328; transport in, 155

ARIZONA. See AMERICA
ARKANSAS. See AMERICA
Ashmouni cotton, 197, 263
Assili cotton, 199
Association Cotonnière Coloniale: Bulletins Nos. 23 and 24, 157; No, 25, 248; Nos. 26 and 27, 330
Ataxia crypta. See Pests
AUSTRALIA, 20, 295
Australian and American cotton: dyeing properties, 272

511 B cotton, 148
"Back-crossing and Its Use in Plant Breeding" (Miles), 175
Bacterium malvacearum. See Blackarm under Diseases
Bagalkoti cotton, 143
Bahtim Abiad cotton, 151
Bailhongal cotton, 318
Baling press (new), 89
BALUCHISTAN, 168
Bambesa cotton, 156
Bamboo locust (*Ceracris kiangsu*). See Locusts (bamboo) under Pests
BARBADOS. See WEST INDIES
Barberton Experiment Station, 4, 191
BAROTSELAND, 237
BELGIAN CONGO:
  "La Bataille du Coton au Congo Belge" (Leplae), 247; "La Campagne Cotonnière 1935-36" (Waelkens), 247; "Compagnie Cotonnèire Congolaise" 279; "Le Coton"—a series of short articles, 328; cotton cultivation, 64; "Cotton Growing in the Belgian Congo" (de Bauw), 277; cotton seed: uses of, 163; "La Culture du Coton dans le District du Congo-Ubangi, 1933-35" (Leontovich), 329; diseases in, 79, 156, 174; "A Disease of Locusts caused by a Bacillus Referred to as 'H'" (Bouvier), 261; "La Ferme Indigène" (Ravet), 329; "Gandajika Station Rpt. for 1935" (L. and D. Soyer), 156; illustrated guide for teaching natives the cultivation of cotton, 329; mixed farming in, 329; "Note sur l'Hibernation du Ver Rose au Congo Belge (*Pectinophora gossypiella* Saund.)" (Bredo), 259; "Observation Relatives à Quelques Hémiptères du Cotonnier" (Leroy), 260; "Organization of Cotton Cultivation in" (Ravet), 155; parasites, 343; pests in, 174, 259, 260, 261, 262, 281; "Le Port et la Pathologie du Cotonnier: Influence des Facteurs Météorologiques" (Steyaert), 174; "La Purification du Triumph Big Boll dans l'Uélé" (Waelkens), 174; "Quelques Données sur l'Expérimentation Cotonnière: Influence de la Date des Semis sur le Rendement" (Pittery), 161; "Rapport de la Station de Selection Cotonnière de Bambesa" (Tondeur), 247; rotation of crops, 329; "Sommaire des Observations faites au Congo Belge et Projet des Futures Recherches sur les Acridiens Migrateurs" (Bredo), 261; statistics of production, 280, 281; U. 4 cotton, 6; varieties of cotton, 162, 247
"Belgian Congo: Cotton Growing in" (de Bauw), 277
Bemisia goldingi. See Pests
B. gossypiperda. See White Fly under Pests. *B. obscurata*. See Parasites
Bengals cotton, 233
Berar cotton, 233
BIKANER. See INDIA
"Biological Control of Insects" (Sweetman), 257; Biological Control of Insect Pests at Farnham House Laboratory, 98
"The Biology of the Thysanoptera with Reference to the Cotton Plant. VIII. The Relation between Variations in Temperature and the Life Cycle" (MacGill), 257
Blackarm. See Diseases
Blackheaded cricket. See Pests
Boll rot disease. See Diseases
Boll weevil. See Pests
Bollworm. See Pests
BOMBAY. See INDIA
Boss III.-16 cotton, 263
"Botany's Importance in the Economic Sphere" (Brierley), 266
Bourbon cotton, 42
Brachymeria euplœæ B. olethrius. See Parasites
BRAZIL:
  Cotton industry, 329; "Cotton Progress in Brazil" (Pearse), 329; "Cotton Production and Export, 1936" (Schneider), 156; "La Culture du Cotonnier au Brésil" (Tissot), 330; diseases in, 171, 263, 349; "Ouro Blanco," 247; pests in, 171, 263, 339, 340, 342
Breeding experiments: at the Corporation's experiment stations, 4 *et seq.*
"Breeding Work,Genetics and Physiology of Cotton," 267
Bremersdorp Experiment Station, 191,239
British Commonwealth Scientific Conference, London, 1936, Rpt. of Proceedings, 182
British Cotton Association, 32nd Ann. Rpt., 1936, 235; work of, in connection with ginning and marketing, 20; assistance rendered in Nyasaland, 21; Southern Rhodesia, 24; Tanganyika, 58; West Indies, 324
British Cotton Industry Research Association: investigation work on Indian cottons, 142; new developments in opening and cleaning machinery, 272; Shirley Analyses, 272; Shirley Lint Recoverer, 272; "Work of" (Peirce), 287; (Pickard), 55
BRITISH GUIANA, 144, 235
Broach cotton, 318
Busoga cotton, 143

California Acala cotton, 267
Callideu bohemani. See Pests
Calliptamus italicus. See Locusts under Pests
Cambodia cotton, 143, 204, 233, 234, 296, 318
Caravonica cotton, 295
Cardophilus dimidiatus. See Pests
CARRIACOU. See WEST INDIES
Cawnpore 520 cotton, 53, 54
"Cell Wall: Investigations on the Formation of" (Hess *et al.*), 355
CENTRAL INDIA. See INDIA
Cercospora gossypii. See Diseases
CEYLON:
  "Agricultural Implements" (Karunaratne), 255; Ann. Rpt. of Dept. of Agr., 1935, 144, 146; cotton cultivation, 1934-36, 146; "Cotton Cultivation in Maho" (Livera), 146; "A Note on the Cotton Purchase Scheme, 1936" (Peiris), 320
Changteh Naked Seed Cotton, 157
Chelonus curvimaculatus. See Parasites
CHINA:
  "A Contribution to the History of the Introduction of Cotton-Growing in" (Grumm-Grzimailo), 64; cotton industry, 1936, 66, 247, 329; cotton progress, 156; cotton research, 1935, 156; cotton spinning and weaving factory to be established, 330; pests in, 166, 168, 339, 341; statistics, 247; "A Study of Farm Economy in, through an Analysis of Farm Accounts in Selected Districts" (Tong and Tu), 247; "The Textile Industries, their Present Positive and Future Possibilities" (Barker), 247
"Chinese cotton: The Amount of Chlorophyll in" (Chi-Pao), 351
"Chinese cotton: Studies on the Inheritance of" (Chi-Pao and Yuen-Ling), 350
Chloridea virescens. See Pests
Chortophaga viridifasciata var. *australior.* See Pests
"Chromatin, Chromosome, Gene" (Haase-Bessell), 176
"Chromosome Conjugation in Interspecific Hybrids" (Skovsted), 268; "Chromosome (Differential) Staining at Meiosis in *G. peruvianum*" (Ellenborn), 88; "Chromosome Morphology in the Genus *Gossypium*: An Investigation of" (Arutjunova), 176
Chrysopa sp. See Lacewing fly under Pests
Chrysops. See Parasites
"The Classification of the Cottons of Asia and Africa" (Hutchinson and Ghose), 353
"Clave Ilustrada de la Especies Cultivados del Genero *Gossypium*" (Clos *et al.*), 267
Cleveland cotton, 155
Cobweb mite. See Red Spider under pests
Coker varieties of cotton, 247
Community cotton growing, 62
"Comparative Anatomy of Seeds of Cotton and Other Malvaceous Plants —I., II." (Reeves), 350
Compost: experiments in use of: Kenya, 159; Uganda, 159; West Indies, 160; "Compost: A Note on Methods of Reducing the Costs in Southern Rhodesia" (Timson), 333; "Compost (Farm)" (Albrecht), 334; "Composts and Composting" (Beckley), 334
Conference on Co-ordination of Agricultural Research in the East African Territories, held at Amani Research Station, Tanganyika, 1936, 76
CONNECTICUT. See AMERICA.
Convergent lady beetle. (*Hippodamia convergens*). See Pests
Corn earworm. See *Heliothis obsoleta* under Pests
"Correlation among the Characters of Asian Cotton Varieties and their F_2 Hybrids: Studies in" (Onodera), 177
Corticium solani. See Damping-off under Diseases
Cosmophila (anomis) flava. See Pests
Cotton: Australian and American—dyeing properties of, 272; "Breeding in the Campaign for Lint Quality in" (Svetasov), 350; "Breeding Work, Genetics and Physiology of," 267; "Classification of the Cottons of Asia and Africa" (Hutchinson and Ghose), 353; "Correlation among the Characters of Asian Cotton Varieties and their F_2 Hybrids: Studies in" (Onodera), 177; "Le Coton du Niger" (Charles-Pierre), 157; "Le Coton est en A.E.F. une Source de Richesse" (Boussard), 157; "Cotton, 1936" (Dodd), 272; Cotton Drawing and Roving.—II." (Merrill), 179; "Cotton Opening and Picking—I." (Merrill), 179; "Croisement Interspécifiques des Cotonniers: Note Complémentaire" (Szymanek), 177; "La Culture du Coton en Espagne" (du Buganda), 157; "La Culture du Cotonnier en Syrie en 1935 (Pignarre), 157; "Disinfection of Cotton Seed: Experiments in the Sudan" (Massey), 301; "Effect of Delayed Harvesting by Picking and Snapping on Six Varieties of Cotton" (O'Kelly and Hull), 256; "Effect of Jute in the Spinning Value of Cotton" (Balls and Hancock), 179; "Effect of Variety, Planting Date, Spacing and Seed Treatment on Cotton Yields and Stands" (Hale), 161; "El Secado Mecanico del Algodon" (Boza and Paez), 256; "Les Facteurs Économiques du Cours des Cotons bruts" (de Prat), 330; "Fumigation of Baled Cotton with Hydrocyanic Acid" (Johnson and Hawkins), 167; "Further Experiments in Egypt on the Nitrogenous and

Phosphatic Manures of" (F. Crowther *et al.*), 325; "Gin Damage of, in Relation to Rainfall" (Smith), 256; "Hand Spinning for Testing of Quality in" (Hutchinson and Panse), 318; Illustrated Key to Varieties of (Clos *et al.*), 267; "Immaturity of, in Northern Nigeria" (Mayo), 86; "Improved Cotton Varieties: Registration of" (Brown), 266; "Improved Method of Ginning Long-Staple Cotton" (Barre), 162; "Influence de la Cultivation du Coton sur la Filature," 330; "Interspecific Hybridization in" (Thaka and Amin), 177; "Mechanical Drying of" (Boaz and Paez), 256; "A New Cotton evolved in Guatemala Resistant to Boll Weevil and Pink Bollworm," 351; "New Species Hybrids" (Skovsted), 268; "A Note on the Hairiness of American Cotton in the Punjab" (Afzal), 86; "Le Port et la Pathologie du Cotonnier: Influence des Facteurs Météorologiques" (Steyaert), 174; "Round Leaf Cotton" (Brown and Cotton), 350; "Seedling Abnormalities in" (Neelakantan and Kontareddy), 350; "Some Reminiscences of the Cotton Crop" (Sampson), 294; "A Study of Ammonia and Nitrate Nitrogen for Cotton. III. Influence of the Nitrogen Concentration in the Nutrient Medium. IV. Influence of Boron Concentration" (Holley and Dulin), 251; "Travaux de Sélection du Coton" (Waelkens), 176; use of, in motor-car industry, 181; for roads, 242; "Valeur Papetière des Tiges de Cotonnier," 330; "Variability of Fibre Length in a Relatively Uniform Strain" (Richmond and Fulton), 270; "Variation in the Character of, in Relation to the Position of Bolls on the Plant" (Sen and Afzal), 269; "What Kind of Cotton *Do* They Want?" (Peirce), 286
"The Cotton Association: Contracts for every Variety" (Nickson), 181
Cotton bags for sugar, 182
Cotton bale enquiry: questionnaire sent out by International Federation, 269
Cotton bollworm. See *Heliothis obsoleta* under Pests
"Cotton Buying and Importing" (Foulkes), 273
Cotton caterpillar. See Leafworm under Pests
"Cotton Embryo: Localization of Pentosans in the Resin Glands of" (Reeves and Beasley), 352
Cotton fibre. See Fibre (Cotton)
Cotton flea hopper. See Pests
"Cotton Flower Pigments: Composition" (Neelakantam and Seshadri), 269
Cotton Geometrid. See Pests
Cotton Gins. See Gins
Cotton hair: "Development and X-ray Structure" (Wergin), 271; "A New Method and Apparatus for Determining the Average Length and Fineness of" (Ahmad and Nanjundayya), 179; "A Note on a New Type of Progressive Damage to the Structure of, caused by Micro-organisms" (Gulati), 78; "Primary Substance: X-ray Diagram and Constitution" (Gundermann *et al.*), 356; "X-ray Investigation during Growth" (Hess *et al.*), 178
Cotton industry activity indices: calculation, 272
Cotton leaf roller (*Sylepta derogata*). See Leaf roller under Pests
Cotton leaf worm (*Alabama argillacea*). See Leaf worm under Pests
"Cotton Linters: Quality of, produced in the United States, Seasons 1934-36" (Fuchs), 327
"Cotton Marketing," 273; (Hess), 90
Cotton for motor cars, 181
"Cotton Plant Pulps: Production" (Macormac and Cameron), 271
Cotton plants: "Carbohydrate Content of, at Different Growth Periods, and the Influence of Fertilizers" (Ergle), 335; "Data on Pests and Diseases of" (Kosubutsky and Stepantsev), 337; "Further Studies on Transport in" Pts. V. and VI. (Mason and Phillis), 83, 84; "Genetics" (Webber), 176; "Nature of Resistance to Stem Weevil" (Dharmarajulu), 76; "Pilosity of, in Relation to Adherence of Dusted Calcium Arsenate" (Dunnam), 173
"Cotton Processing" (Chadwick), 89
Cotton Research Station, Trinidad, 6, 16, 82, 242, 352
Cotton for roads, 242
"Cotton Rotations: The Value of Grassland Cultivation in" (Wells), 69
Cotton Seed. See Seed
Cotton Seed Farm, Nigeria. See Daudawa Seed Farm
"Cotton and Spinning Machinery: Testing" (McConnell), 89
Cotton stalks: value in paper making, 330
"Cotton and Staple Fibre Yarns: Comparison" (Grote), 178
Cotton statistics. See Statistics
Cotton stem weevil. See Stem weevil under Pests
"Cotton Supplies and Prices" (Slater), 90
"Cotton Supply by Free Labour," 215
Cotton varieties. See Varieties of cotton
"Cotton Varieties: Competition between, in Adjacent Rows" (Quinby *et al.*), 335
Cotton web-spinner. See Pests
Cotton worms (*Prodenia litura*). See Pests
"Cotton Yarns: Irregularity of" (Turner), 271; "Lea Strength and Count Relationship" (Campbell), 357; "Moisture Relations" (Setzer), 179; "Strength Calculation" (Meyer), 180

"Cottonseed Lint: Determination" (McKinney and Jameison), 88, 179
Cottonseed meal: use of, as a fertilizer in tobacco cultivation, 245
"Cottonseed oil: The Isolation from, of an Alcohol Resembling Alpha Tocopherol from Wheat Germ Oil" (Emerson and Evans), 257; "Production of, in Argentina," 16
"Cottonseed Oil Production: Chemistry and Technology of," a collection of articles in Russian with English summaries, 256
C.P. No. 1 cotton, 233
Crazy-top disease. See Diseases
"Crinkled Dwarf in *Gossypium hirsutum* L.: On the Occurrence of" (Hutchinson and Ghose), 353
Criquet pèlerin. See Locusts under Pests
"Croisement Interspécifique des Cotonniers: Note Complémentaire" (Szymanek), 177
"Crop Ecology: Studies in. I. The Composition of the Cotton Crops of Central India and Rajputana" (Hutchinson and Ghose), 234
"Crossing: A Possible Base of Selecting Parents for" (Lazarev), 267
"Crossing (Intervarietal) of Self-pollinated Plants" (Lysenko), 267
"Currie, Sir James: An Appreciation" (J. C. May and L. G. Killby), 185
CYPRUS: Ann. Rpt. of Dpt. of Agr., 1935, 55; cotton cultivation, 55, 236; "Injurious Insects of" (Morris), 257; "Irrigation in" (Pitcairn), 55; Meso-white cotton, 236; pests in, 72, 236, 257; "Soil Erosion in" (Pitcairn), 332; varieties of cotton, 55
Cytology: "Investigations on the Formation of the Cell Wall" (Hess *et al.*), 355; "Recent Advances in," second edition (Darlington), 268; "Twenty-five Years of, 1910-1935" (Allen), 354
"Cytological Studies in Cotton—Pt. IV.: Chromosome Conjugation in Interspecific Hybrids" (Skovsted), 268; "Cytological Technique: Improvements in" (LaCour), 354

Damping-off disease. See Diseases
Daudawa Seed Farm, 7, 15
Dectitus albifrons. See Pests
"Deflowering, the Rôle of, in Cotton Production" (Singh and Choudhri), 126
Delfos cottons, 155, 267
Delinting of cotton seed, 161, 254, 346
Delta cotton, 326
Deltapine cotton, 266
"Delrect I" cotton, 203
Dept. of Scientific and Industrial Research, Rpt. for 1935-36, 144, 145
Derœocoris oculatus. See Pests
"The Design of Experiments," second edition (Fisher), 254
"Deviation of the Mean Method—Suggestion of a New Formula for" (Yang), 254; "Deviations (Standard) of Observations: An Abbreviated Method and a suggested Cheap Mechanical Device for Calculating" (Spencer-Smith and Todd), 254
Dibrachys sp. See Parasites
Diseases: "Annotated Host List o Uganda Plant Diseases" (Hansford), 343; "Cotton Diseases in Bombay, 1934-35" (Uppal), 79; "in Egypt" (Fahmy), 343; "In North Carolina, 1936" (Shaw), 343; "In Sudan, 1934-35" (Massey), 170; "Cotton Seed Disinfection Experiments to Control Bacterial Diseases of the Cotton Plant" (Laycock), 78; "Cultural Measures of Controlling Plant Diseases" (Anstead), 170; "Development of Systematic Control against, in Old-established Cotton-growing Districts in Russia," 164; "Disease of Locusts in Belgian Congo" (Bouvier), 261; "Étude des Facteurs Météorologiques Régissant la Pullulation du *Rhizoctonia solani* Kuhn. sur le Cotonnier" (Steyaert), 79; "L'Immunité aux Maladies Bactériennes des Plantes" (Savulescu), 170, 343; "The Nature of Immunity from Disease in Plants" (Butler), 170; "New Fungus Names proposed by C. G. Lloyd" (Stevenson and Cash), 344; "A New Type of Progressive Damage to the Structure of Cotton Hair Caused by Micro-organisms" (Gulati), 78; "Notas sobre Algunas Enfermedades del Algodonero" (Fawcett), 344; "Phytopathological and Physiological Studies on, in America," 80; "Plant Diseases: An Introduction to Research on," etc. (A. J. and R. S. Ricker), 262; "O Podridão Interna dos Capulhos do Algodoeiro no Estado de São Paulo" (Krug), 263; "On the Problem of the Nature of the Action of Bacteriorhizal Micro-organisms on Plants" (Isakova), 344; protection of cotton against, in Russia, 164; "A Rapid Method for Determining the Wilting Co-efficient of Soils" (Bouyoucos), 265; "Serological Method for the Determination of Varietal Resistance to Disease in Cotton" (Fedotova), 78; "Soil-borne Fungus Diseases of Field and Plantation Crops" (Garrett), 344; "Some Effects of, on Variability of Yields" (Hartley and Rathbun-Gravatt), 343; "Some Notes on the Incidence of Disease and Resistance to Pathological and other Adverse Conditions in Crops of Sind" (Thadani), 263; "A Study of Immunity of Plants to Infectious Diseases" (Vavilov), 78; "Studies in Disease Resistance. I. Cotton Wilt and Environment" (Ambegaokar and Wad), 80; "Tests of

the Toxicity of Sulphur Compounds to the Group of Bacteria causing Rots of Vegetables and Spotting of Tobacco, French Beans and Wheat, and Gummosis of Cotton" (Kapshuk), 264. *Angular leafspot:* Egypt, 343; Queensland, 240; Russia, 346; West Indies, 6, 150. *Anthracnose,* 348. *Areolate mildew:* see *Ramularia areola. Blackarm:* "Bactericidal Properties of Hydrogen Sulphide as a Control" (Vzoroff), 171; "Invasion of Cotton Seed by" (Tennyson), 344. In Argentina, 344; Belgian Congo, 174; Russia, 78, 264, 346; Sudan, 56, 57, 78, 148, 170, 202, 239, 302, "Investigations under Field Conditions" (Andrews), I., 78, II., 345; Uganda, 149. *Boll rot,* 79. *Cercospora gossypina,* 344. *Corticium solani:* see Damping-off. *Crazy-top,* 263. *Damping-off,* 79, 171, 343. *Empusa grylli,* 258. *Eremothecium ashbyii,* 264. *External boll disease,* 150, 242. *Frisolée,* 174. *Fusarium buharicum,* 78, 165. *Fusarium wilt:* see Wilt. *Gibberella moniliformis,* 348. *Glomerella gossypii:* see Damping-off. *Gregarina locustæ,* 76. *Gummosis,* 264, 345, 346. *Heterodera marioni:* see Root-knot. *Internal boll rot,* 156, 171, 263. *Leaf crinkle,* 263. *Leaf curl:* in Sudan, 6, 56, 57, 148, 171, 201, 239. *Leaf roll,* 81. *Macrophomina phaseoli,* 81, 172, 346. *Nematospora coryli. N. gossypii:* see Internal boll rot. *Oxoniosis,* 172. *Ozonium root rot:* see Root rot. *Penicillium:* see Internal boll rot. *Phymatotrichum omnivorum:* see Root rot. *Ramularia areola,* 348. *Red Leaf:* in India, 81, 144, 263. *Rhizoctonia,* 242, 348. *R. bataticola,* 79. *R. solani,* 79. *Root knot,* 245. *Root rot:* "Penetration and Invasion of, in Cotton Roots Grown under Pure Culture Conditions" (Watkins), 347. Root rot in America, 80, 172, 347; Argentina, 344; India: in Gujarat (Likhite), 172; in Punjab, 1935-36, 320; "Studies on, in Punjab" (Vasudeva), II., 79, III., 348. *Rust,* 173, 245. *Schizophyllum commune,* 348. *Sclerotium rolfsii,* 348. *Small-leaf,* 80. *Sore-shin,* 343. *Stem rot,* 348. *Stenosis,* 172. *Sterigmatocystis,* 76. *Verticillium albo-atrum:* see Wilt. *Verticillium dahliæ,* 78. *Virus diseases,* 173, 265, 266, 349. *Wilt:* "Diagnostic Evaluation of the Morphological and Cultural Characteristics in the Genus *Fusarium*" (Riallo), 172; "Fertilizers to Control" (Young), 173; "Taxonomy of the Genus *Fusarium* and a Method for the Determination of the Species belonging to it" (Raillo), 348. Wilt in America, 80, 173, 245, 264, 348, 349; Brazil, 349; Egypt, 173; India, 80, 173; Peru, 264; Philippines, 348; Russia, 164, 172, 348; Uganda, 58, 149

Disinfection of cotton seed: 59, 78, 301, 335, 346
Dissosteira carolina. See Pests
Dixie Triumph cotton, 162
Dodiotico cotton, 81, 346
Domira Bay Station, 56
D.P.L. cotton, 155
"Duplicate Genes for Corolla Colour in *Gossypium barbadense* L. and *G. darwinii* Watt" (Harland), 82
Durango cotton, 241
Dysdercus spp. See Stainers under Pests

Earias chromataria, E. citrina, E. fabia. See Pests. *Earias insulana.* See Spiny Bollworm under Pests
Early Days of Cotton Growing in the U.S.A., 41
"Early Development of the Cotton Fibre" (Sheffield), Letter from G. S. Ayyangar, 141. Errata notices, 91, 182.
East Africa: Mixed Farming in—I. (Ball), II. (Maher), III. (Lipscomb), 162; IV. (Guy), 236
East Africa: Transport in, 236
East African Agricultural Research Station, Amani, Tanganyika. See Amani Research Station
"East African Cottons: Staple Length" (Kapadia), 146
East Malling Research Station, Ann. Rpt. for 1936, 320
"La Economia Algodonera Norteamericana" (Mata), 328
"The Effect of Delinting of Cotton Seed with Sulphuric Acid on Germination and Yield" (Hamid and Mohammad), 161; "The Effect of Jute on the Spinning Value of Cotton" (Balls and Hancock), 179; "The Effect of Leaf Curl Disease on the Yield of the Cotton Plant" (Andrews), erratum notice, 91; "The Effect of Raising the Middle Roller and Some Other Factors on the Yarn Strength of Sindhi Cotton" (Ahmad), 162; "The Effect of Variety, Planting Date, Spacing, and Seed Treatment on Cotton Yields and Stands" (Hale), 161
EGYPT:
  "Alexandria Futures Market" (Barber), 325; Anti-mixing Law, 151; Bahtim Abiad Cotton, 151; "Breeding and Propagation of New Cotton Varieties in" (Pilavachi), 151; "Contro of Pink Bollworm: Recent Advances in" (Kamal), 338; Cotton Ginners' Association formed, 151; cotton roads in, 242; "Disease Investigations in" (Fahmy), 173, 343; "The Effect of Jute on the Spinning Value of Cotton" (Balls and Hancock), 179; "Experiments in the Interaction of Crop Growth"—III. (F. Crowther), 152; IV. (F. Crowther *et al.*), 153; VI. (F. Crowther *et al.*), 325; "Latest

Developments of Ginning and Steam Pressing in" (Pilavachi), 151; "New Egyptian Cotton Contract in Liverpool" (Todd), 61; parasites in, 338; pests, 151, 259, 338; "Review of 1935-36 Cotton Season," 151; "Some Pink Bollworm Studies in" (Bishara), 259; "Source of Egypt's Wealth: The Romance of Cotton" (Balls), 151; "Spinning Procedure for Cotton Samples" (Hancock), 356; "Spinning Test Station at Giza: Progress Report" (Hancock), 152; statistics, 46, 49, 73, 222, 227, 311, 314, 316, 317; varieties of cotton, 242; "A White Cotton for Egypt" (Fouad Bey Abaza), 152
Egyptian bollworm (*Earias insulana*). See Spiny Bollworm under Pests
Egyptian cotton: Bahtim Abiad cotton, 151; "The Egyptian Cotton Section of the Lancashire Cotton Industry in the 1935-36 Season" (Windel), 151, 182; "Giza Varieties" (Brown), 151· "Note on the Outlets for, by Countries and Varieties" (Jehia), 61; prices, 47, 51, 137, 140, 224, 229; "Strength of" (Hancock), 242; "Strength, Grade and Fineness of" (Hancock), 325; "Tendering of, in Liverpool" (Boumphrey), 151; "Water-weight Changes in Export and Country Bales" (Balls), 61; "What is New in Breeding Egyptian Cottons?" (Avtonomov), 351; "The Yarn Strength of" (Hancock), 151
Egyptian Cotton Yearbook, 1935-36, 151
Elasmus philippinensis. See Parasites
Empire cotton crops, 230
"Empire Cotton Growing: Development and Progress" (Sir Wm. Himbury), 55
Empire Cotton Growing Corporation: Origin of, 1 *et seq.*; Sir James Currie's work for, 185; research work financed by, 16; work on insect problems in South Africa, etc., 191; assistance rendered in Nigeria, 7; Nyasaland, 4, 10, 56; Northern Rhodesia, 4, 10; Southern Rhodesia, 4, 10, 24; South Africa, 4, 10, 191; Sudan, 200; Swaziland, 9, 191, 239; Tanganyika, 10, 58
"Empire Cotton Supplies: Maintenance of" (Himbury), 145
Empoasca (*Chlorita*) *biguttula*. See Pests
Empoasca fabæ, E. facialis. See Jassid under Pests
Empusa grylli. See Diseases
Encoptolophus texensis. See Pests
Entedon sp. See Parasites
Entomology: Imperial Institute of, 97
"Entomological Equipment and Methods, A Manual of" (Peterson), 336
Eremothecium ashbyii. See Diseases
Errata notices, 91, 183, 358
"Estudia Economio de la Produccion y Consumo de Aceites Comestibles en la Argentina" (Mata), 163
Eucelatoria australis. See Parasites
Euproctis. See Hairy caterpillar under Pests
Eurytoma sp. See Parasites
"An Examination of an Analysis of a Serial Experiment" (Hutchinson and Panse), 335
"Experiments in Egypt on the Interaction of Factors in Crop Growth" III. (F. Crowther), 152; IV. (F. Crowther *et al.*), 153; VI. (F. Crowther *et al.*), 325
Experiment Stations: Nyasaland, 56; Queensland, 240; Northern Rhodesia, 31, 238; Southern Rhodesia, 147, 238; South Africa, 4, 191; Swaziland, 191, 239; West Indies, 6, 16, 82, 242
Express cotton, 155
External boll disease. See Diseases

4 F, 36 F, and 43 F cottons, 54
"Fabrics: Iban and Sea Dyaks, and their Patterns" (Haddon and Start), 180
"Fabrics (Cotton) for Road Making" (Watson), 181; "in America" (Cheatham and Whitaker), 89
"Farm Compost" (Albrecht), 334; "Farm Manure: Its Value and Conservation" (Collison and Conn), 334
Farm Relief Cottons, 162, 174, 247
Farnham House Laboratory, 98
Ferguson cotton, 241
Ferrisiana virguta. See Pests
"Fertility: The Restoration and Maintenance of" (Howard), 251
Fertilizers: "Carbohydrate Content of Cotton Plants at Different Growth Periods and the Influence of Fertilizers" (Ergle), 335; "Gutterfly as an organic manure in India" (Bal), 250; "A Study of Ammonia and Nitrate Nitrogen for Cotton," III., IV. (Holley and Dulin), 251; use of compost in Kenya, 159; Uganda, 159; West India, 160. Fertilizer experiments in America, 154, 171, 244, 245, 246, 334; Egypt, 152, 153; India, 250, 252; Nigeria, 333; Southern Rhodesia, 160; West Indies, 160, 242
"Fibres (Cellulosic) Structure" (Farr), 271
Fibres (Cotton), 178, 269, 270
Fibres (Industrial), 88
Fibres (Textile), 180, 356
Fibres (Vegetable), 178
"Fibre Cross-Sections: Preparation" (Von Bergen), 355
"Field Experiments, the Evolution of" (Wishart), 160
FIJI: Agr. Journal, Vol. III., No. 1, 1937, 235; Ann. Bulletin of Divisional Rpts., 1935, 144, 150; "Cotton Buying and Ginning" (Field), 241; cotton cultivation, 1934-36, 150; Sea Island cotton cultivation, 150
Fiji Backcross cotton, 150
Flea beetle. See Pests
FLORIDA. See AMERICA

Flower thrips. See Thrips under Pests
FORMOSA, 169, 337
Fouadi cotton, 201
Frankliniella fusca, F. gossypium, F. tritici. See Thrips under Pests
FRENCH COLONIES, 74, 157, 169, 248, 330
Frisolée. See Diseases
"Fumigation: Recent Advances in, and the Need of Fumigation Practice" (Munro), 254
"Further Studies on Transport in the Cotton Plant" Pt. V. (Mason and Phillis), 83
Fusarium buharicum. See Diseases. *F. vasinfectum.* See Wilt under Diseases
Futures prices, 47, 51, 136, 140, 223, 229, 317

GAMBIA, 55
Gandajika cotton, 156
Garden webworm. See Pests
Garofallou cotton, 201
Gasterocercodes gossypii. See Pests
Gatooma Experimental Station, 147, 238
Genetics: "Twenty-five Years of, 1910-35" (Blakeslee), 355; "The Gene, its Function and its Meaning in Genetics" (Stroer), 177; "The Genetics, Breeding and Seed Production of Cotton," 81; "Genetics of Cotton"—XVI., "Some Observations on the Inheritance of Form and Size in Asiatic Cottons" (Hutchinson), 82; XVII., "Increased Mutability of a Gene in *G. purpurascens* as a consequence of Hybridization with *G. hirsutum*" (Harland), 267; Genetics memoirs, 82, 268; "Genetics and Plant Breeding: Recent Developments in" (Phipps), 175; "Züchtung der Baumwolle" (Bordakov). A review of the literature on the genetics of cotton, 81
Genetic terms, a glossary of, 355
GEORGIA. See AMERICA
GERMANY, 248
GEZIRA. See SUDAN
Gibberella moniliformis. See Diseases
Gins: "Double Cotton Gin" (Platt Bros.), 162; "History of" (Roe), 70; "Regulation of, as Public Utilities in Oklahoma" (Ballinger), 62; "Volkart Double Roller Gin" (Vock), 162
"Gins (Saw), Care and Maintenance of" (Bennett and Gerdes), 336
Ginneries: "Power Requirements in" (Stedronsky), 70; "Suggestions to Managers of" (Field and Briggs), 70; Ginneries in America, 328; Nyasaland, 21; Sudan, 56, 200, 239; Tanganyika, 21; Uganda, 20
Ginners' Association, Formation of, in Egypt, 151
Ginning of cotton: Work of the British Cotton Growing Association, 20, 21; "Effect of Raising the Middle Roller and Some Other Factors on the Yarn Strength of Sindhi Cotton" (Ahmad), 162; "L'Égrenage du Coton": papers by M. Pilette, 256; "Gin Damage of Cotton in Relation to Rainfall" (Smith), 256; "Ginning Investigations in America" (Bennett), 70; (Bennett and Gerdes), 70; (Gerdes and Bennett), 71; "Improved Methods of Ginning Long Staple Cotton" (Barre), 162; licences for, in Uganda, 149; "Rates for Ginning and Wrapping American Cotton, 1928-29—1935-36" (Wright and Lanham), 244
Gitori beckeri. See Pests
Giza varieties of cotton, 55, 61, 151, 152, 153, 201, 242; "Giza Varieties of Cotton" (Brown), 152, 153
Glomerella gossypii. See Damping-off under Diseases
Goghari cotton, 212
GOLD COAST: Ann. Rpt. of Dpt. of Agr., 1935-36, 144, 146; cotton cultivation in 1935-36, 146; "Handbook, 1937," 235, 237; "Mixed Farming, to be Adapted to Local Conditions" (Lynn), 231; motor transport in, 19
Gossypium anomalum, 87, 176, 354; *G. arboreum,* 87, 234; *G. arboreum* var. *neglectum,* 295, 354; var. *typicum,* 354; var, *cernuum,* 354; *G. aridum,* 87; *G. armourianum,* 87; *G. Bakeri,* 354; *G. barbadense,* 78, 82, 87, 247, 353, 354; *G. Darwinii,* 82; *G. harknessii,* 87; *G. herbaceum,* 78, 80, 85, 164, 176, 177, 295; *G. herbaceum,* var. *typicum,* var. *frutescens,* var. *africanum,* 354; *G. hirsutum,* 78, 87, 176, 177, 198, 295, 353, 354; *G. hopi,* 327; *G. neglectum,* 80, 126, 234; *G. peruvianum,* 88; *G. punctatum,* 177; *G. purpurascens,* 198; *G. religiosum,* 354; *G. roseum,* 234; *G. stocksii,* 176, 254; *G. Sturtii,* 176; *G. tribolum,* 87; *G. triphyllum,* 354; *G. vitifolium,* 177, 197
Graphocephala versuta. See Pests
Grasshoppers. See Pests
GREECE, 81, 157, 346
Gregarina locustæ. See Diseases
GRENADA. See WEST INDIES
Grey field mouse. See Pests
"Growth Hormones in Plants" (Boysen-Jensen), 354
GUATEMALA: A new cotton evolved resistant to boll weevil and pink bollworm, 351
Gummosis. See Diseases
"Gutterfly" as organic manure, 250

Habrocytus sp. See Parasites
Hairy Caterpillar (*Euproctis* sp.). See Pests
Half-and-Half cotton, 155, 161, 241, 245
Hand spinning of cotton, 318
"Haploids in Polyembryonic Seeds of Sea Island Cotton" (Harland), 87
"Haploids and Polyploids: the Experimental Production of," 87

Harvesting machinery. See Picking machinery
"Heat Treatment of Plants, a Portable Chamber for" (Brink), 255
Heliothis obsoleta (variously designated American bollworm, corn earworm, cotton bollworm). See Pests
Heliothis virescens. See Pests
Helopeltis bergrothi. See Pests
"Helping to Build an Empire Industry" (Killby), 1 *et seq.*
Heterodera marioni. See Root knot under Diseases
Hippodamia convergens. See Convergent lady beetle under Pests
Hopi cotton, 62, 88, 243, 326, 327
Hubli-Kumpta cotton, 318
"Humus, the Manufacture of, from the Wastes of the Town and Village" (Howard), 334; "Humus, Origin, Chemical Composition and Importance of, in Nature" (Waksman), 68
HYDERABAD. See INDIA
Hyderabad Gaorani cotton, 319

"Iban, or Sea Dyak Fabrics and their Patterns" (Haddon and Start), 180
"Immaturity in Northern Nigerian Cotton" (Mayo), 86
"Imperial Agricultural Bureaux" (Chadwick), 93 *et seq.*
Imperial Bureau of Soil Science, Rpt. for 1936-37, 235, 249
Imperial College of Science and Technology, 29th Ann. Rpt., 1936, 274
Imperial College of Tropical Agriculture, Trinidad: work of, 2; Rpt. for 1935-36, 274
Imperial Institute, Ann. Rpt. for 1936, 235, 273
"The Improvement of Native Agriculture in Relation to Population and Public Health" (Hall), 235
"Incomplete Randomized Blocks" (Yates), 334
India:
"Agriculture and Animal Husbandry in India 1933-34 and 1934-35" (new title for "Review of Agricultural Operations in India"), 233; Conference of Research Workers on Cotton, 1937, 232; "Correlation of Weather Conditions and Yield of Kumpta Cotton, Dharwar District" (Ramakrishnan), 319; Cotton Control Act, 212, 234; Cotton Ginning and Pressing Factories Act, 209, 232, 234; Cotton Pressing Factories: List of Names and Owners, etc., 1936-37, 319; Cotton Transport Act, 207, 232; diseases in, 78, 79, 80, 81, 144, 172, 173, 263, 320, 348; "Economic and Commercial Conditions, Rpt. for 1935-36" (Ainscough), 143; fertilizer experiments, 250; "Use of Molasses for" (Dhar) 252; "Ginning experiments" (Ahmad), 162; "Hand-spinning for Testing Quality of Cotton" (Hutchinson and Panse), 318; Imperial Council of Agricultural Res., Ann. Rpt. for 1935-36, 53; improvement of cotton, in, 318; Indian Merchants' Chamber, Ann. Rpt., 1935, 53; "Indian Trade Commissioners' Rpt., 1935-36" (Meek), 142; "Interspecific Hybridization in Cotton" (Thaka and Amin), 177; Lancashire Indian Cotton Committee, 142, 143, 232; legislation, 180, 206, 232; "Legislation (Cotton) in the Bombay Presidency" (Jenkins), 206; "Malvi Cottons: Studies in" (Hutchinson and Kubersingh), 85; mixing of cotton varieties, 212; parasites in, 262; pests in, 74, 75, 76, 77, 86, 168, 169, 260, 262, 319; "pulichai" cotton: prohibition of cultivation, mixing and sale of, in Madras for a further three years, 234; "Rpt. of Operations of Dept. of Agriculture, 1936," 319; Review of Agricultural Operations in India, 1931-1933, 53; "Science and Practice of Agriculture in" (Visva Nath), 318; Sea Island cotton cultivation in Kanara, (Rau), 144; "Seed: Effect of Delinting with Sulphuric Acid on Germination and Yield" (Hamid and Mohammad), 161; soils in, 331; "Soil Management: Some Methods of" (Bal), 250; statistics, 134, 138, 221, 226, 233, 311, 315, 316, 317; "Studies in Crop Ecology: the Composition of the Crops in Central Asia and Rajputana" (Hutchinson and Ghose), 234; "Studies in Plant Breeding Technique," I. (Hutchinson and Kubersingh), 85; "Tiruppur-Cambodia Cotton: Characteristics" (Kusebauch), 144; varieties of cotton, 53, 54, 143, 144, 233, 234, 263, 296, 297, 318. *Bikaner*, 53. *Bombay:* "Bombay Cotton Annual, 1935-36," 143; "Cotton Diseases, 1934-35" (Uppal), 79; "Cotton Legislation" (Jenkins), 206; Conference of Research Workers on Cotton, 1937, 232. *Central India:* 54, 234. *Hyderabad*, 319. *Indore*, 232, 233. *Madras*, 144, 234. *Mysore*, 144. *Punjab:* cotton cultivation, 1935-36, 319; New Jubilee cotton, 319; "A Note on the Hairiness of American Cotton in" (Afzal), 86; "Preliminary Note on Cotton Failure in, and Some Abnormalities in the Plant" (Dastur), 86; "Summary of Experimental and Research Work, 1930-35," 53, 54. *Rajputana*, 54, 234. *Sind*, 54, 263
Indian cottons: Investigations on, by the British Cotton Industry Research Association, 142; "A Guide to," 318; "Review of 1935-36 Season" (Chunilal, Mehta and Co.), 143; "Spinning Test Reports on" (Ahmad), 54, 143, 233, 318; "Spinning Tests on Mixtures of Staple Fibres and Indian Cottons" (Ahmad), 233; statistics, 134, 138,

221, 226, 233; "Supply and Distribution of Various Types, 1934-35," 143; "Technological Reports on" (Ahmad), 54, 233; "On Trade Varieties," 234
Indian Cotton Chart, 1936-37 (Chunilal, Mehta and Co.), 357
Indian Cotton Industry: Distribution of Looms and Spindles, 233; "Protection of," 53
Indian Cotton Situation, 1929-35, 143, 318
Indian Central Cotton Committee, Ann. Rpt., 1936, 232; establishment of, 207; investigations financed by, 53,168, 232; progress made during 1933-35 seasons, 233; publicity notices, 53; spinning test reports, 54, 143, 233, 318; Technological Research Laboratory, work of, 54, 143, 232, 233, 234
Indian Science Abstracts, 144
Indio Acala cotton, 241
Indore compost system, 334
Indore Institute of Plant Industry, 232, 233
Ingold cotton, 346
"The Inheritance of Form and Size in Asiatic Cottons: Some Observations on" (Hutchinson), 82
Insects. See Pests.
"Insect Pests of the Cotton Plant: A Note on a New Method of Control by Means of Selenium" (Mason and Phillis), 308
Insidious flower bug. See *Orius insidiosus* under Pests
"Interchange between the Tissues of the Corolla" (Phillis and Mason), 84
Internal boll rot. See Diseases
"Interspecific Hybridization in Cotton" (Thaka and Amin), 177
"Intervarietal Crossing of Self-Pollinated Plants" (Lysenko), 267
Irrigation: Cyprus, 55; Sudan, 57; "Irrigated Lands: Maintaining the Production of" (Lyon), 336
Ishan cotton, 202
ITALY, 339
Italian Somaliland, 248

Jagadia cotton, 318
JAPAN:
  Cotton industry competitive power, 157; "Cotton Industry: Development and Trade with America" (Proctor), 248; "Cotton and Rayon Industries: Competitive Power" (Rupprecht), 248; pests in, 166, 167, 169, 338; piece-goods exports, 1936, 248; textile industries: prospects, 157
Jassid. See Pests
Jayawant cotton, 233
Jinja cotton, 143, 318
Jubilee cotton, 319

Kadi-viramgan cotton, 318
Kampala cotton, 143, 318
Karunganni cotton, 143, 157, 297
KENYA COLONY:
  Ann. Rpt. of Dept. of Agr., 1935, Vol. II., 144, 146; cotton cultivation, 1935-36, 56, 146; fertilizer experiments, 159; pests, 147; soil erosion problems, 56; use of compost in, 159; varieties of cotton, 56
Khandesh cotton, 233
King cotton, 346
Kivu cotton, 162
KOREA, 167, 339
Kumpta cotton, 143, 319

Labour problems: Sudan, 239
Lacewing fly (*Chrysopa* sp.). See Pests
Lake Copais Co. Ltd., Greece, 157
"Lancashire Cotton Industry" (Hesketh), 273
Lancashire and the Future: The Present Position and Prospects of the Cotton Industry, 357
"Lancashire's Present and Future Position in Textiles: Taking Stock" (Nasmith), 357
Lancashire Indian Cotton Committee, 142, 143, 232
Laphygma exigua, L. frugiperda. See Pests
LBAR cotton, 202
Leaf crinkle; Leaf curl; Leaf roll. See Diseases
Leaf roller; Leaf worm. See Pests
Legislation: America, 181; India, 180, 206, 232; "In the Bombay Presidency" (Jenkins), 206; Nigeria, 180; Southern Rhodesia, 180
Lightning Express cotton, 162
"Lint Quality in Cotton: Breeding in the Campaign for" (Svetasov), 350
Locusts. See Pests. *Locusta migratoria migratorioides.* See Locusts under Pests
Læmophlœus minutus. See Pests
Lonestar cotton, 155, 162, 240, 241, 243
LOUISIANA. See AMERICA
Loxostege affinitalis. See Cotton web-spinner under Pests
Lygus; L. simonyi. See Pests
Lysiphlebus (*Aphidus*) *testaceipes.* See Parasites.

M.A.11 cotton, 144
Maarad cotton, 153, 242, 351
"Machinery: Cultivation" (Ransomes, Sims and Jefferies, Ltd.), 255; "Opening and Cleaning" (Williams), 272; "Picking" (Dow), 163
Macrophomina phaseoli. See Diseases
Macrosiphum (*Acynthosiphon*) *gossypicola* sp. n. See Pests
MADAGASCAR, 75
MADRAS. See INDIA
MALTA, 320
Malvi cotton, 54, 85, 232, 234
Malwa cotton, 234
Manchadores. See Stainers under Pests
Marie Galante cotton, 60, 61, 241, 324

Marketing of Cotton: Work of the British Cotton Growing Association, 20
Mazabuka Experiment Station, 31, 76, 238
Meade cotton, 154, 244
Mealy bug. See Pests
Mebane cotton, 156, 241
Melanoplus differentialis; M. femur-rubrum; M. mexicanus. See Pests
Melinophora inglesiasi, sp. n. See Pests
Memoirs of the Cotton Research Station, Trinidad: Genetics No. 13, "Genetics of Cotton," Pt. XVI. (Hutchinson), 82; Genetics No. 14, "Chromosome Conjugation in Interspecific Hybrids" (Skovsted), 268; Physiology No. 8, "The Concentration of Solutes in Sap and Tissue, and the Estimation of Bound Water" (Mason and Phillis), 82; Physiology No. 9, "Further Studies on Transport in the Cotton Plant," Pt. VI. (Phillis and Mason), 84; Physiology No. 10, "The Effects of Light and Oxygen on the Uptake of Sugar by the Foliage Leaf" (Phillis and Mason), 352
"Mendel's Work: Has it been rediscovered ?" (Fisher), 175
Mescinia peruella. See Pests
Mesowhite cotton, 55, 236
MEXICO, 66, 158
Mexican Big Boll cotton, 155
Microbracon brevicornis; M. isomera; M. kirkpatricki; M. lefroyi; M. mellitor; M. nigrorufum; M. onukii; M. recessus. See Parasites
"The Microscope" (Gage), 174
Microtermes. See Pests
"The Migration of Solutes" (Mason and Phillis), 269
"Mildewed Cotton Fibres: Microscopy" (Grote), 178
Miller cotton, 241
Million Dollar cotton, 319
MISSISSIPPI. See AMERICA
MISSOURI. See AMERICA
Mitafifi cotton, 197
Mixed Farming: The Importance of, 13; "Mixed Farming in East Africa"—I. (Ball), II. (Maher), III. (Lipscomb), 162; IV. (Guy), 236. Mixed farming in Belgian Congo, 329; East Africa, 162, 236; Gold Coast, 321; Nigeria, 321
Moglai cotton, 233
"Molasses, Nitrogen, Fixation and Land Reclamation" (Dhar), 252
Mole crickets. See Pests
Mollisoni cotton, 53, 54, 86, 319
MONTSERRAT. See WEST INDIES
MOROCCO, 157, 248
MOZAMBIQUE, 76
Mumtaz cotton, 198
"Mutations and Natural Selection" (Gates), 267
Muttia cotton, 318
Mycology: Imperial Institute of, 97
MYSORE. See INDIA
Myzus persicæ. See Pests

N. 17 cotton, 56
Nahda cotton, 55
Nanded cotton, 318
"Native Agriculture: The Improvement of, in Relation to Population and Public Health" (Hall), 235
"Natural Selection and Evolutionary Progress" (Huxley), 175
Navrotskii cotton, 350
Navsari cottons, 212, 318
Nematospora; N. coryli; N. gossypii. See Internal Boll-rot under Diseases
NEVIS. See ST. KITTS-NEVIS under WEST INDIES
New Boykin cotton, 241
"A New Method of Arranging Variety Trials Involving a Large Number of Varieties" (Yates), 69
NEW MEXICO. See AMERICA
New uses for cotton, 242, 273
Nezara viridula. See Pests
NIGERIA:
  Eleventh Ann. Bulletin of Dept. of Agr., 1932, 55, 86; cotton cultivation, 1935-36, 147; 1936-37, 321; Daudawa Seed Farm, 7, 15; diseases in, 78; "Disinfection of Cotton Seed" (Laycock, 78; Empire Cotton Growing Corporation, assistance rendered by, 7; fertilizer experiments, 333; "Half-yearly Report to Sept. 30, 1936, 147; to March 31, 1937, 321; "Immaturity in Nigerian Cotton" (Mayo), 86; legislation, 180; mixed farming in, 321; pests in, 262; prices, 147. *Northern Provinces:* Ann. Rpt. for 1936, 320, 321; cotton cultivation, 1935-37, 147; 1935-36 and 1936-37, 321; "Effect of Farmyard Manure in Northern Nigeria" (Hartley), 333; "Report on a Visit to study Mixed Farming" (Lynn), 321. *Southern Provinces:* cotton cultivation, 1935-37, 147; 1936-37, 321
Nomadacris septemfasciata. See Locusts
Non-replicated factorial experiments (Cornish), 160
NORTH CAROLINA. See AMERICA
NT.2 cotton, 202; NT.15, 204; NT.38, 144
NYASALAND:
  Ann. Rpt. of Dpt. of Agr., 1935, 55, 56; cotton cultivation, 1934-35, 56; 1935-36, 237; cotton prospects, 1936-37, 147; Domira Bay Station, 56. Empire Cotton Growing Corporation, assistance rendered by, 4, 10, 56; ginneries, assistance of British Cotton Growing Association, 21; pests in, 75, 237; prices, 56; Progress Rpt., Geological Survey Dept., No. 6, 1936, 320; "Relation between Climate and Pests and Diseases of Cotton" (Ducker), 76; a criticism of (Allan), 76;

Report of Entomologist, 1935 (Smee), 258; statistics, 56; U.4 cotton, 5
Nyasaland Upland cotton, 203

Officers on leave, 91, 183, 274, 358
OKLAHOMA. See AMERICA
Orius insidiosus (Insidious flower bug). See Pests
" Ouro Blanco " journal of Brazil, 247
Ozonium root-rot. See Root-rot under Diseases
Oxoniosis. See Diseases
Oxycarenus bicolor; O. lætus. See Pests
" Oxygen Supply and the Activation of Diffusion " (Mason and Phillis), 83

Pachyneuron siphonophoræ. See Parasites
Parasites: " Annotated Host List of Uganda Parasitic Fungi and Plant Diseases," I. and II. (Hansford), 343; "Parasites introduced into Barbados for the Control of Insect Pests " (Tucker), 72; " On Some Parasites found in Association with the Stem Weevil Pest of Cotton in South India " (Ayyar and Margabandhu), 262. *Apanteles sagax*, 258, 343; *A. syleptæ*, 258; *A. thurberiæ*, 150; *Brachymeria euplœæ*, 166; *B. obscurata*, 166; *B. olethrius*, 258; *Chelonus curvimaculatus*, 258; *Chrysops*, 166; *Dibrachys*, 166, 338; *Elasmus philippinensis*, 166; *E. platyedra*, 338; *Entedon*, 258; *Eucelatoria australis*, 73; *Eurytoma*, 166; *Habrocytus*, 338; *Lysiphlebus* (*Aphidus*) *testaceipes*, 166; *Microbracon brevicornis*, 338; *M. isomera*, 166; *M. kirkpatricki*, 72, 258, 339; *M. lefroyi*, 339; *M. mellitor*, 339; *M. nigrorufum*, 166; *M. onukii*, 166; *M. recessus*, 258; *Pachyneuron siphonophoræ*, 166; *Pimpla*, 166; *P. roborator*, 157, 338; *Pleurotropis*, 338; *Pristomerus*, 166; *P. vulnerator*, 166; *Rhogas*, 73; *Trichogramma evanescens*, 343; *T. minutum*, 168
Patanga succincta. See Locusts under Pests
" Pedology " (Joffe), 249
Pempheres affinis. See Stem weevil under Pests
Penicillium. See Internal boll rot under Diseases
" Pentosans in the Resin Glands of the Cotton Embryo: Localization of " (Reeves and Beasley), 352
PERSIA, 158
Personal Notes, 91, 183, 274, 358
PERU:
Cotton production, 158, 249; diseases, 264; " Memoria de la Junta Directiva de la Sociedad Nacional Agraria, 1934-35," 249; parasites, 73; pests, 72, 165, 258; proposed station for the supply of improved Tanguis seed, 158; statistics, 249
Peruvian kidney cotton, 197

Pests: Appointment of Mr. F. A. Squire to investigate cotton pests in British West Indies, 59; " El Arrebiatado y Otros Insectos Daninas al Algodonero en los Valles del Norte del Peru " (Wille *et al.*), 258; " Biological Control of Insects " (Sweetman), 257; " The Biology of the Thysanoptera, with Reference to the Cotton Plant. VIII. The Relation between Variations in Temperature and the Life Cycle " (MacGill), 257; control by selenium, 308; " Cotton Pests Investigations in the Windward Islands " (Squire), 258; " A Criticism of Above Paper " (Allan), 76; " Development of Systematic Control against, in Old-Established Cotton-Growing Districts in Russia," 164; Empire Cotton Growing Corporation's work on insect pest control in South Africa and Swaziland, 10, 191; Entomological Equipment and Methods: A Manual of " (Peterson), 336; Entomologist's visit to Montserrat to study the cotton pest problem, 150; " Injurious Insects of Cyprus " (Morris), 257; " Insect Pests: Study and Control of," 337; " Insect Pests of the Cotton Plant: A Note on a New Method of Control " (Mason and Phillis), 308; " Insects infesting Stored Cotton Seed in America " (Bissell), 165; " Insects in Relation to Plant Viruses " (Leach), 163; " Light Traps to Control in Central Asia " (Bogush), 258; " A List of Cotton Insects of the World " (Li and Ma), 72; " List (Annotated) of Insects Injurious to Cotton in Tanganyika " (Harris), 166; " Little-known Cotton Insects: Additional Notes on " (Folsom), 164; " A New Apparatus for Separating Insects and Other Anthropods from the Soil " (Ladell), 72; " Observations relative à quelques Hémiptères du Cotonnier " (Leroy), 260; " On Some New Aleurodidæ " (Corbett), 262; " Os ' Manchadores ' do Algodão (*Dysdercus* sp.) " (Mendes), 263; " Plagas del Algodonero en la Campaña Agricola, 1935-36 " (Wille), 165; " A Preliminary List of Insect Pests and their Host Plants in Siam " (Beller and Bhenchitr), 165; protection of, cotton from, in Russia, 164; " Relation between Climate and Pests and Diseases of Cotton " (Ducker), 76; " The Rôle of Insects and Fungi in Agriculture," letter from Dr. Harland, 52; " Tests against Cotton Pests of some Plants that Produce Essential Oils " (Kayunov), 165. *Acacia aphid*, 337. *Agrotis*, 168. *A. ypsilon*, 167. *Alabama argillacea:* see Leafworm. *American bollworm:* see *Heliothis obsoleta*. *Anomis luridula*, 73. *Anthonomus vestitus*, 73, 165. *Aphids:*

coloured insecticides for, 340; " Further Studies on " (Rainwater), 167; " Improved Device for Artificial Feeding of " (Pletsch), 340; "In West Indies: Experiments to Control by Selenium " (Mason and Phillis), 308. " Toxicity of Selenium containing Plants to " (Hurd - Karrer), 308, 340; *Aphis gossypii :* Cyprus, 258; Formosa, 337; Japan, 338; Korea, 167; Peru, 165, 258; Russia, 165; Siam, 165; Tanganyika, 58. *A. laburni :* see *Acacia aphis.* *Apion xanthostylum :* see Weevil stem borer. *Ataxia crypta,* 264. *Bemisia goldingi,* 262. *B. gossypiperda :* see Whitefly. *Blackheaded cricket,* 319. *Boll weevil,* 258, 259, 338. *Bollworm,* 190, 237. *Callidea bohemani,* 166. *Carpophilus dimidiatus,* 165. *Chloridea virescens,* 340. *Chortophila viridifasciata* var. *Australior,* 265. *Chrysopa :* see Lacewing fly. *Cobweb mite :* see Red spider. *Convergent lady beetle,* 77. *Corn earworm :* see *Heliothis obsoleta.* *Cosmophila (anomis) flava,* 337. *Cotton bollworm :* see *Heliothis obsoleta.* *Cotton caterpillar :* see Leafworm. *Cotton flea-hopper,* 74, 166, 246, 259, 340. *Cotton Geometrid,* 341. *Cotton leafworm :* see Leafworm. *Cotton web spinner,* 240, 260. *Cotton worm,* 73, 166. *Criquet pélerin :* see Locusts. *Cutworms,* 168, 240. *Decticus albifrons,* 258. *Deræocoris oculatus,* 260. *Dissosteira carolina,* 265. *Dysdercus ruficollis :* see Stainers. *D. urichi :* native to Trinidad, 76. *Earias chromataria,* 337. *E. citrina,* 166. *E. fabia :* Formosa, 337; Japan, 338; Siam, 165. *E. insulana :* see *Spiny bollworm.* *Egyptian bollworm :* see Spiny bollworm. *Empoasca (Chlorita) biguttula,* 337. *E. fabæ, E. facialis :* see Jassid. *Encoptolophus texensis,* 265. *Euproctis :* see Hairy caterpillar. *Ferrisiana virguta,* 338. *Flea beetle,* 166. *Frankliniella fusca, F. tritici :* see Thrips. *Frankliniella gossypiana :* a new name for the thrips *Erithrips gossypii,* 169. *Garden webworm,* 246. *Gasterocercodes gossypii,* 73, 165, 258. *Gitona beckeri,* 258. *Graphocephala versuta,* 166. *Grasshoppers,* 246, 319. *Grey field mouse,* 261. *Hairy caterpillar,* 319. *Heliothis obsoleta* (variously designated American bollworm, corn earworm, cotton bollworm): " The Cannibalistic Habits of " (Barber), 73; " Experiments for the Control of Larvæ of " (Carruth), 73; " Lead Arsenate and Wetting Agents to Control " (Fulton), 73; " Methods of Rearing Corn Earworm Larvæ " (Barber), 167; " Observations on Poison Baits for Control " (Ditman), 341; " Parasitised by *Trichogramma minutum* " (Barber), 168; " Reaction of, to Light Traps " (Carruth and Kerr), 341; " Studies on " (Ditman and Cory), 341. *H. obsoleta :* Cyprus, 72 ; Kenya Colony, 147; Queensland, 240; Northern Rhodesia, 31; Southern Rhodesia, 25, 147, 238, 338; Russia, 164, 337, 341; Sudan, 56, 57, 166. *Heliothis virescens,* 165. *Helopeltis bergrothi :* Belgian Congo, 174, 260; Tanganyika, 58, 258, 260; Uganda, 149. *Hippodamia convergens :* see Convergent lady beetle. *Insidious flower bug :* see *Orius insidiosus.* *Jassid :* America, 166; Belgian Congo, 260; India, 86; Kenya Colony, 147; Queensland, 149, 240; Northern Rhodesia, 31; Southern Rhodesia, 147, 238, 338; South Africa, 191, 238; Sudan, 166; Swaziland, 191; Tanganyika, 58, 166; Uganda, 149. *Lacewing fly,* 77. *Laphygma exigua,* 72, 377. *L. frugiperda,* 264. *Leaf roller :* China, 337; Formosa, 337; India, 74; Kenya Colony, 147; Sudan, 166; Tanganyika, 258. *Leafworm :* America, 246, 264; Argentina, 64; Egypt, 151; Peru, 165; West Indies, 59, 60, 324. *Locusts :* " Ainde sobre os Inimigos de Gafanhoto Vermelho " (Cardoso), 75; " Bionomics and Ecology of the Moroccan Locust in Middle Asia " (Ivanov), 342; " Compte rendu Sommaire sur les Recherches de la Mission d'Études de la Biologie des Acridiens dans la Région Tchad en 1935 " (Zolotarevsky), 169; " Conditions of Existence and Individual Variability in the Asiatic Locust " (Zolotarev), 168; " An Ecological Reconnaissance of the Suspected Middle Niger Outbreak Area " (Lean), 75; " Effect of Solar Radiation and Micro-climate upon the Body Temperature and Behaviour of the Larvæ of *Locusta migratoria* " (Strel'nikov), 75; " Une Épidémie chez les Sauterelles migratrices en Congo Belge. Isolement d'un Bacille Pathogène. Essais de Transmission de la Maladie " (Bouvier), 261; " État des Recherches sur les Sauterelles Migratrices " (Vayssière), 261; " Étude sur la Sauterelle Migratrice *Nomadacris septemfasciata* et sa Présence à Madagascar de 1926 à 1935 " (Frappa), 75; " Investigations of Outbreaks in China during 1935 " (Woo and Cheng), 168; " International Organisation of Anti-Locust Research, etc." (Vayssière), 261; " Locusts " (Mehta), 260; " Locust Incursion of 1935 in N.W. India: Its Significance in the Study of the Locust Problem " (Ramchandra Rao), 168 ; locusts killed by a Fungus *Sterigmatocystus* sp. in Portuguese East Africa, 76; " Phase Variation and Rate of Development in

Red spider (*Tetranychus telarius*). See Pests

Reports from Experiment Stations. See Progress Reports from Experiment Stations

"The Restoration and Maintenance of Fertility" (Howard), 251

Rhizoctonia bataticola, R. solani. See Diseases

RHODESIA (NORTHERN):
  Ann. Rpt. of Dpt. of Agriculture, 1936, 320, 322; cotton industry, 1935-36, 237; cotton trials, 322; Empire Cotton Growing Corporation: assistance rendered by, 4, 10; Mazabuka Research Station, 31, 238; pests in, 31, 76, 322; "The Pest and the Plant" (Bebbington and Allan), 31; "Relation between Climate and Pests and Diseases of Cotton" (Allan), 76; soils in, 32; U. 4 cotton, 5

RHODESIA (SOUTHERN):
  Ann. Rpt. of Dpt. of Agriculture and Lands, 1936, 235, 238; "Compost: A Note on Methods of Reducing the Costs" (Timson), 333; cotton cultivation, 1935-36, 238; 1936-37, 238; Cotton Research and Industry Board, 28, 238; Empire Cotton Growing Corporation, assistance rendered by, 4, 10; fertilizer experiments, 160; Gatooma Experiment Station, 147, 238; legislation, 180; "Notes on Cotton Growing in" (Peat), 56; pests in, 25, 147, 169, 238, 338; "Tsetse Fly Control" (Jack), 169; "Soil Conservation" (Aylen and Roberts), 251. "Some Aspects of the Promotion of Cotton Growing in" (Cameron), 24; U. 4 cotton, 5, 25

Rhogas sp. See Parasites

"Road Making Fabrics" (Watson), 181

"Rôle of Insects and Fungi in Agriculture" (Howard), Letter from Dr. Harland, 52

Root-knot. See Diseases

Root-rot. See Diseases

Rotation of crops: Belgian Congo, 329; Queensland, 69

Rothamsted Experimental Station: Ann. Rpt. for 1935, 66; 1936 (abridged), 320

"Round Leaf Cotton" (Brown and Cotton), 350

"Row Competition and Its Relation to Cotton Varieties of Unlike Plant Growth" (Hancock), 267

Rowden cotton, 55

RUSSIA:
  Breeding experiments, 85, 267, 350; "With Egyptian Cotton" (Avtonomov), 351; cotton cultivation, 158, 330; "Cotton Regions of Azerbaijan" (Zukovskii), 330; cottonseed oil production: a collection of papers on, 256; diseases in, 78, 164, 171, 172, 264, 337, 345, 346, 348; diseases and pests: protection of cotton against, 164; extension of cotton cultivation, 249; "Importance of Local Cottons of Afghanistan for Breeding Work in Russia" (Bordakov and Ivanova), 85; New Textile Mill, 330; "Odessa Institute of Plant Breeding: Some Remarks of the Work of" (Konstantinov *et al.*), and reply (Lysenko), 354; pests, 75, 77, 164, 165, 168, 258, 337, 341, 342; "Investigations against Cotton Pests on Some Plants that produce Essential Oils" (Kayumov), 165; "Light Traps to control" (Bogush), 258; research work in, 176, 267; seed, delinting of, disinfection of, 346; "Special Mead" cotton, 330; "Textile Industry: Economics" (Wagner), 66; transport in, 20

Rust. See Diseases

Rutherglen bug. See Pests

Saissetia nigra. See Pests

Sakel cotton, 186, 201

Sakha cottons, 55, 151, 201, 242

Sakrand Research Station, 54

Salems cotton, 143

Salt marsh caterpillar. See Pests

"Saw Gins: Care and Maintenance of" (Bennett and Gerdes), 336

Schistocerca americana ; S. obscura. See Pests. *S. gregaria ; S. paranensis.* See Locusts under Pests

Schizophyllum commune. See Diseases

"Science of the Year, 1936. The Biological Sciences" (Brierley), 266

"Science and Practice of Agriculture in India" (Visva Nath), 318

"The Scientific Principles of Plant Protection, with Special Reference to Chemical Control" (Martin), 77

Sclerotium rolfsii. See Diseases

"Sea Island Cotton" (Sands), 241; "Haploids in Polyembryonic Seeds of" (Harland), 87; "Review of 1935-36 Season" by Molyneux, Taylor and Co., 59; Sea Island cotton in America, 41, 245; Fiji, 150; Kanara, 144; Puerto Rico, 249; Sudan, 201; West Indies, 7, 59, 60, 61, 150, 242

Sea Island 2-4 cotton: India, 263; Sea Island (Red) cotton: West Indies, 242

"Section Cutting by a Modified Plate Method" (Preston), 88

Seed: "Ceresan Treatment of" (Smith *et al.*), 255; "Comparative Anatomy of the Seeds of Cotton and other Malvaceous Plants"—I., II. (Reeves), 350; delinting of, 161, 254, 346; disinfection of, 59, 78, 301, 335, 346; "Invasion of, by *Bacterium malvacearum*" (Tennyson), 344; "Pests Attacking" (Bissell), 165; "Process of Mutation in Ageing Seed" (Nawaschin), 177; seed extension schemes in India, 318; "Theoretical and Practical Importance of Rejuvenation of" (Rjabov), 177

"Seedling Abnormalities in Cotton" (Neelakantan and Kontareddy), 350
"Seedling Culture in Sand to prevent Damping-off" (Dunlap), 171
"Seeds and Motes: Position of, in Locks and Length of Cotton Fibres from Bolls borne at Different Positions on Plants at Greenville, Texas" (Porter), 86
"Seed Cotton: Drying and Air Resistance" (Balsson), 72
"Selenium Absorption by Crop Plants as Related to their Sulphur Requirement" (Hurd-Karrer), 333; "Selenium Occurrence in Certain Soils in the U.S. with a Discussion of Related Topics" (Byers), 333; Selenium treatment of plants to control insect pests (Mason and Phillis), 308
"Selfing Cotton Flowers: An Inexpensive Method": Letter from R. L. Knight, 231
Semi-looper. See Pests
Sennar tree cotton, 197
S.G. cottons, 162, 247
Shirley Analyzer, 272; Shirley Institute. See British Cotton Industry Research Association. Shirley Lint Recoverer, 272
SIAM, 165
Sibinia planiuscula. See Pests
Simon's Heater, 59
SIND. See INDIA
Skinner's Cotton Trade Directory of the World, 1936-37, 90
Small leaf disease. See Diseases
Soils: "Applicability of Alkaline Permanganate for Oxidation of Organic Matter in, for Mechanical Analysis" (Chakraborty), 331; "A Brief Review of the Mechanical Analysis of" (Novak), 67; "Chemical Nitrification in" (de Rossi), 332; "Determination of Nitrogen in" (Subramanyan), 69; "Development and Significance of the Great Soil Groups of the U.S." (Kellogg), 67; "Direct Microscopic and Bacteriological Examination of" (Rossi *et al.*), 67; "Dispersion of Soil for Mechanical Analysis by Sodium Carbonate or Sodium Oxalate Treatment" (Puri), 331; "Effect of Soil on Plant Growth and Stainer Damage in Northern Rhodesia," 32; hairy vetch and Austrian winter peas for soil improvement in Alabama, 244; "L'Importance de la Réaction du Sol en Culture Cotonnière et l'Utilité de l'Emploi des Cendres" (de Saeger), 332; "Maintenance of Soil Fertility in Uganda" (Martin and Biggs), 240; "Mobilization of Plant Nutrients in the Soil" (Barthel), 69; "Pedology" (Joffe), 249; "Principles of Chemical Characterization of the Soil" (de Sigmund), 67; "A Rapid Indirect Method for Determining the Wilting Coefficient of" (Bouyoucos), 265; "The Restoration and Maintenance of Fertility" (Howard), 251; "Soil Conservation in Southern Rhodesia" (Aylen and Roberts), 251; "Soil Management: Some Methods of" (Bal), 250; "Soil Microbiology" (Cutler and Crump), 331; (Waksman), 331; "Soil Problems: South Africa," 192; "Sudan" (Greene), 250; "Tropical Soils in Relation to Tropical Crops," 66; "Utilization of Certain Forms of Inorganic Nitrogen during the Decomposition of Plant Materials in Soils" (Shrikhande), 69
"Soils and Fertilizers" (Crowther), 250
"Soil acidity: On the Nature of Reactions Responsible for"—IV., V., 67
"Soil Conditions and Plant Growth" (Russell), 330
Soil erosion: "Control of" (Ayres), 332; (Lowdermilk), 67; "Erosion, Plant Growth and Soil Varieties" (Fick), 159; a home-made level for obtaining the line of contour banks, 68; "The Menace of" (Hall), 67; "Natural Protection from" (Timson), 332; "Pasture Contour Furrowing Machine" (Logan), 68; "The Problem of Wind-Eroded Lands" (van Vuren), 251; "Rainfall, Soil Erosion and Run-off in South Africa" (Thompson), 159; "Soil Erosion" (Lester Smith), 251; terracing implement to conserve soils, 68. Soil erosion: America, 67; Cyprus, 332; Kenya Colony, 56; South Africa, 68, 159, 193; Tanganyika, 58; Uganda, 58
"Soil Moisture: Does Cultivation Conserve it?" (Esselin), 160
"Soil Samplers" (Coile), 250; (Heyward), 158
Soil Science: Imperial Bureau of, Rpt. for 1936-37, 235, 249
"Some Aspects of the Promotion of Cotton Growing in Southern Rhodesia" (Cameron), 24
"Some Cotton Problems in South Africa" (Milligan), 189
"Some Reminiscences of the Cotton Crop" (Sampson), 294
Sore-shin. See Diseases
SOUTH AFRICA:
  Ann. Rpt. of Dpt. of Agr., 1936, 145, 147; Barberton Experiment Station, 4, 191; Co-operative movement in, 238; cotton industry, 1935-36, 147, 238; 1936-37, 238; Empire Cotton Growing Corporation: assistance rendered in pest investigations, 4, 10, 191; "Moisture and Farming in" (Thompson), 322; "Organization of Agriculture, with Special Application to South Africa" (Leppan), 322; pests in, 4, 10, 190, 191, 238, 261; soil problems, 68, 159, 192, 193; "Some Cotton

Problems of" (Milligan), 189; U.4 cotton, 5, 12, 191; Year Book, 1934-35, 145
SOUTH CAROLINA. See AMERICA
South and East Africa Year Book, 91
South-Eastern Agricultural College, Wye: *The Journal*, January, 1937, 144; July, 320
S × P cotton, 154
SPAIN, 157
Special Mead cotton, 330
Spharagemon cristatum. See Pests
Spinning costs reduction: a discussion of the "Dawes" system, 271; "Spinning Machinery Testing" (McConnell), 89; spinning mills, 89, 271, 355; "Spinning Procedure for Cotton Samples" (Hancock), 356; "Spinning Room: Value of Controlled Humidity" (Thompson), 89
"Spinning Tests: on Indian Cottons" (Ahmad), 54, 233, 318
Spiny bollworm (*Earias insulana*) (also designated Egyptian bollworm and Spotted bollworm). See Pests
Spot prices, 47, 51, 136, 140, 224, 229, 317
Spotted bollworm. See Spiny bollworm under Pests
Stainers. See Pests
Statistics: Carryover, 46, 49, 136, 139, 222, 227, 312, 315; Consumption, 45, 50, 135, 136, 139, 222, 223, 228, 273, 312, 316; "Cotton Statistics" (Todd), 45, 134, 221, 310; Empire Crops, 3, 230; World's Crops, 45, 49, 221, 225, 273. Statistics: America, 45, 48, 135, 136, 139, 140, 221, 226, 310, 314, 315, 316, 317; Belgian Congo, 280, 281; China, 247; Egypt, 46, 49, 222, 227, 311, 314, 316, 317; India, 134, 138, 221, 226, 233, 311, 315, 316, 317; Nyasaland, 56; Peru, 249; Sudan, 135, 138
"Statistics: A Handbook of, for Use in Plant Breeding and Agricultural Problems" (Shaw), 266; "Some Principles of, and their Application to Agricultural Experiments," 160, 254; "Statistical Analysis: Methods of" (Goulden), 334; "Statistical Methods and their Application to Agronomy" (Gula Roy and Mahalanobis), 160, 254
Stemborer. See Pests. Stem rot. See Diseases. Stem weevil (*Pempheres affinis*). See Pests
Stenosis. See Diseases
Sterigmatocystis. See Diseases
Sthenarus leucochilus. See Pests
Stink bug. See Pests
ST. KITTS-NEVIS. See WEST INDIES
ST. LUCIA. See WEST INDIES
Stoneville cottons, 154, 155, 161
"Studies in Crop Ecology. I. The Composition of the Crops of Central India and Rajputana" (Hutchinson and Ghose), 234
ST. VINCENT. See WEST INDIES
SUDAN:
"513" cotton, 57; Ann. Rpt. of Agricultural Research Service, 1935, 55, 57; Ann. Rpt. of Administration, Finance and Conditions in 1935, 55, 56; Ann. Rpt. of Dpt. of Agriculture and Forests, 1935, Pt. II., 145, 148; Ann. Rpt. of Dpt. of Economics and Trade, 1935, 55; "Cotton Growing" (Benson), 148; "Cotton Growing and Breeding in" (Trought), 197; cotton industry, 1934-35, 56; 1935-36, 56, 239; 1936-37, 239; "Cotton Research Work, 1934-35" (Trought), 148; diseases, 6, 56, 57, 78, 148, 201, 239, 302, 345; "Diseases in 1934-35" (Massey), 170, 171; Empire Cotton Growing Corporation, assistance rendered by, 200; ginneries in, 56, 200, 239; "Investigations on Blackarm Disease" (Andrews), I., 78; II., 345; irrigation experiments, 57; labour problem, 239; pests in, 56, 57, 148, 166, 171, 239; Plant Breeding Section: work of, 199; "Seed Disinfection Experiments" (Massey), 301; Sennar tree cotton, 197; "Soil Problems" (Greene), 250; statistics, 135, 138; varieties of cotton, 6, 56, 57, 148, 197, 239; X1530 cottons, 56, 239. *Gezira:* cotton industry, 56; diseases in, 6,78, 345; "Water Duty Trials" (Greene), 57
Sudan bollworm. See Red bollworm under Pests
Sudan Plantations Syndicate, 198
Sunflower cotton, 203
Super Cleveland cotton, 162
Surat cotton, 318
SWAZILAND:
Ann. Rpt. of Social and Economic Progress, 1935, 235; Bremersdorp Experiment Station, 191, 239; cotton cultivation, 1935, 239; 1936-37, 323; Empire Cotton Growing Corporation: assistance rendered by, 9, 191, 239; pests, 191; transport (motor), 239; work of the plant breeder, 9
Sylepta derogata. See Leaf roller under Pests
SYRIA, 157

TANGANYIKA:
Amani Research Station, 76, 101, 148; Ann. Rpt. of Dept. of Agriculture, 1935, 55, 58; British Cotton Growing Association, assistance rendered by, 58; Conference on Co-ordination of Agricultural Research in East African Territories, 1936, 76; cotton cultivation, 1934-35, 58; 1935-36, 239, 323; 1936-37, 240. East African Research Station: see Amani Research Station. Empire Cotton Growing Corporation: assistance rendered by, 10, 58; ginneries in, 21; motor transport trials, 20; parasites, 258; pests, 58, 166, 240, 258, 260, 261, 262; soil erosion, 58; Trade

Report, 1936, 320, 323; U.4 cotton, 5, 58
Tanguis cotton, 158, 201; Tanguis underwear yarn, 180
Tarache notabilis. See Semilooper under Pests
" Technological Reports on Indian Cottons " (Ahmad), 54, 233; " On Trade Varieties of Indian Cottons " (Ahmad), 234
Technological Research Laboratory, Bombay, 54, 143, 232, 233, 234
TENNESSEE. See AMERICA
Terracing implements for soil conservation, 68
Tetranychus telarius. See Red spider under Pests
Tettigonia viridissima. See Pests
TEXAS. See AMERICA
Texas root rot. See Root rot under Diseases
Textile fibres. See Fibres (Textile)
Textile Industry: Tripartite Conference on, 326
" Textile Materials: A Portable Ultra-Violet Fluorescence Lamp for the Examination of " (Derrett-Smith), 357
" Theoretical and Practical Importance of Seed Rejuvenation " (Rjabov), 177
Thespesia rogersii: host plant of stainers, 36
Thrips, T. tabaci. See Pests
Tinnevelly cotton, 143, 295
Tiruppur-Cambodia cotton, 144
Tomonotus axtecus. See Pests
" The Translocation of Solutes in Plants: A Critical Consideration of Evidence bearing upon Solute Movement " (Curtis), 352
Transport in East Africa, 236
Transport (motor), 18, 19; Australia, 20; Gold Coast, 19; Russia, 20; Swaziland, 239; Tanganyika, 20; Uganda, 20
Transport (rail), Argentina, 155
" Travaux de Sélection du Coton " (Waelkens), 176
Tribolium ferrugineum. See Pests
Trice cotton, 155, 346
Trichogramma evanescens; T. minutum. See Parasites
Trifidaphis phaseoli. See Pests
Trimerotropis citrina. See Pests
TRINIDAD and TOBAGO. See WEST INDIES
Tripartite Technical Conference on the Textile Industry—I. Record of Proceedings, 326
Triumph cotton, 155, 174, 247, 277
" Tropical Agriculture: A Notebook on " (Wood), second edition, 357
Tropical Hygiene, 182
Tropical Soils in Relation to Tropical Crops, 66
Tsetse fly. See Pests
Tydewater cotton, 154, 244

U.4 cotton: in African colonies, 5, 12; Belgian Congo, 156, 162; Kenya Colony, 56, 146; Nyasaland, 147; Southern Rhodesia, 25; South Africa, 191; Tanganyika, 58; Uganda, 5, 149
UGANDA:
Ann. Rpt. of Dept. of Agriculture, 1935-36, Pt. I., 55, 58; Pt. III., 145, 148; " Annotated Host List of Uganda Parasitic Fungi and Plant Diseases " (Hansford), 343; Cotton Industry, 1935-36, 58, 148; 1936-37, 58, 149, 240; 1937-38, 323; Cotton Reports, 1935-36: Botanical, Entomological and Mycological Sections, 148; diseases in, 149, 343; fertilizer experiments, 159; ginneries in, 20; ginning licence fees, 149; motor transport in, 20; parasites, 343; pests, 58, 149; " Investigations on Pink Bollworm " (Taylor), 339; ploughing in, 58; prices, 240; soil erosion problem, 58; " Soil Fertility: Experiments on the Maintenance of " (Martin and Biggs), 240; U.4 cotton, 5, 149; use of compost in, 159
Ujjain cotton, 233
Umri Bani cotton, 234

V.135 cotton, Montserrat V.135 cotton, 242
Varieties of cotton: " Competition between Adjacent Rows " (Quinby *et al.*), 335; " Illustrated Key to " (Clos *et al.*), 267); in America, 154, 155, 234, 244, 266; Argentina, 246; Australia, 295; Belgian Congo, 162, 247; Cyprus, 55; Egypt, 242; India, 53, 54, 143, 144, 233, 234, 263, 296, 297, 318; Kenya Colony, 56; Queensland, 241; Sudan, 57, 148, 197
" Variety Trials: A New Method of Arranging, Involving a Large Number of Varieties " (Yates), 69
Vegetables fibres. See Fibres (Vegetable)
Vegetable oils and oilseeds, 163
VENEZUELA, 66
Ver rose or *Verme rosa.* See Pink bollworm under Pests
Vernalization, 267, 354
Verticillium albo-atrum. See Wilt under Diseases. *V. dahliæ.* See Diseases.
Verum cottons, 233, 234
" Village Waste " (Wood), 160
Virus diseases. See Diseases

Washington cotton, 266
" Water Duty Trials in the Sudan Gezira " (Greene), 57
" Water-weight Changes in Export and Country Bales of Egyptian Cotton " (Balls), 61
Web-spinner. See Cotton web-spinner under Pests
Webber cotton, 203
Weeds susceptible to root-rot disease, 347
Weevil stemborer. See Pests

WEST INDIES:
Appointment of Mr. F. A. Squire as Entomologist for cotton-pest investigations, 59; first half-yearly report on investigations in the Windward and Leeward Islands, 258; "Boll Weevil: Precautionary Measures against the Introduction of, into Eastern West Indies" (Skeete), 338; British Cotton Growing Association, assistance rendered by, 324; cotton industry, 1935-36, 241; diseases in, 150; fertilizer experiments, 160, 242; Marie Galante cotton, 241, 242; parasites in, 72, 150; pests, 60, 72, 76, 150, 258, 324; selenium to control, 308; Sea Island cotton crop, 1935-36 and 1936-37, 241, 324; "The Sea Island Cotton Industry" (Sands), 241; "Sea Island Cotton: Review of 1935-36 Season" by Molyneux, Taylor and Co., 59; Red Sea Island cotton, 242; seed treatment by Simon's Heater, 59; West Indian Sea Island Cotton Association, 324; "Zyklon B" for fumigation purposes, 59. *Anguilla*, 60, 242, 324. *Antigua*, 150. *Barbados:* Agr. Journal of Dept. of Science and Agriculture, 1936, Vol. II., 55, 59; cotton industry, 1935-36, 59; parasites, 72; Peasant Cotton Plot Competition, 59; pests in, 72. *Carriacou*, 324. *Grenada*, 320, 324. *Nevis:* See *St. Kitts-Nevis*. *Montserrat:* Ann. Rpt. of Dept. of Agriculture, 1935, 55, 60; change of planting date, 241; cotton industry, 1935 and 1936, 59, 60; diseases in, 150; pests in, 59, 60, 150; report on Entomologist's visit to study cotton pest problems, 150. *St. Kitts-Nevis:* Ann. Rpt. of Dept. of Agriculture, 1935, 55, 60; cotton industry, 1935-36, 60; 1936-37, 324; pests in, 60; "Sea Island Cotton in" (Kelsick), 242. *St. Lucia:* Cotton cultivation re-established on a small scale, 59, 60. Research Abstract: Rpt. of Dept. of Agriculture, 1935, 55. *St. Vincent:* Ann. Rpt. of Dept. of Agriculture, 1935, 235; cotton industry, 1935-36, 60, 242; 1936-37, 60, 150, 242; Cotton Experiment Station, 6, 242; diseases in, 6, 242; fertilizer experiments, 242; pests, 242; purification of Sea Island cotton in, 7. *Trinidad and Tobago:* Admin. Rpt. of Dept. of Agriculture, 1935, 55; Cotton Research Station, 16, 82, 352; Memoirs of Cotton Research Station, 82, 84, 268, 352; "Experiments in Compost Making" (Wood), 160; Imperial College of Tropical Agriculture Rpt. for 1935-36, 274; pests in, 76

West Indian Sea Island Cotton Association, 4th Ann. General Meeting, 1936, 150
Westerns Javaria cotton, 143
"What Kind of Cotton *do* they want?" (Peirce), 286
White ants, White fly (*Bemisia gossypiperda*). See Pests
Wilds cotton, 350
Wilt. See Diseases
W.N.27 Desi cotton, 126
Wonder Dixie Triumph cotton, 162
"World Cotton Consumption: Rise in" (Windel), 90
World's Cotton Production and Consumption, 273
World cotton prospects: with a review of American cotton, 62

X04729 cotton, 148; X1530 cotton, 56, 57, 202, 239; X1530 A cotton, 148, 202, 239; X1750 cotton, 202; XA129 cotton, 204; XA1129 cotton, 203

Yarns. See Cotton Yarns.

Zagora cotton, 242
"Züchtung der Baumwolle" (Bordakov), 81
"Zyklon B" disinfectant, 59

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher

I. A. R. I. 75.

INDIAN AGRICULTURAL RESEARCH
INSTITUTE LIBRARY,
NEW DELHI.

Date of issue.	Date of issue.	Date of issue.
29.4.60		
1 MAR 1969		

MGIPC—S5—38 AR/54—7-7-54—7,000.